ORNL/TM-2012/570

OAK RIDGE NATIONAL LABORATORY
DEPARTMENT OF ENERGY

Site Sustainability Plan (SSP) with FY 2012 Performance Data

December 7, 2012

SUSTAINABLE CAMPUS INITIATIVE

OAK RIDGE National Laboratory

ORNL/TM-2012/570

Energy and Transportation Science Division

Site Sustainability Plan (SSP) with FY 2012 Performance Data

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I. Executive Summary

Oak Ridge National Laboratory (ORNL) is both the largest science and energy laboratory of the Department of Energy (DOE) and one of the oldest national laboratories still operating at its original site. These characteristics provide a unique opportunity to integrate sustainability into our facilities and activities.

As a leading performer of clean energy research and development (R&D), ORNL delivers advances in energy efficiency, renewable energy, and environmentally sound and cutting-edge technology and practices. ORNL is committed to accelerating the deployment of these advances in support of DOE's goal of catalyzing the timely, material, and efficient transformation of the nation's energy system and securing US leadership in clean energy technologies.

A comprehensive modernization effort, undertaken to provide ORNL with a 21st century research environment, provided the starting point for the Sustainable Campus Initiative, a 10-year effort to achieve benchmark levels of sustainability across ORNL. This aggressive campaign will continue the transformation of ORNL's physical environment and enable us to meet DOE goals for energy management and environmental performance.

As outlined in this report, the Sustainable Campus Initiative is leveraging the outcomes of our DOE-sponsored R&D programs to maximize the efficient use of energy and natural resources across ORNL. Wherever possible, ORNL is integrating technical innovations into new and existing facilities, systems, and processes. We continue to pursue and deploy innovative solutions and initiatives to advance regional, national, and worldwide sustainability. We are also taking actions to transform ORNL's culture and engage employees in supporting sustainability at work, at home, and in the community. In its current structure, ORNL's Sustainable Campus Initiative consists of 26 unique projects or roadmaps, ranging from foundational methods to transformational technologies as represented in Figure 1.

ORNL has achieved numerous successes during FY 2012 that are detailed throughout this document; an abbreviated list of highlights includes

- Commissioned the Biomass Steam Plant, a key to exceeding Scope 1 greenhouse gas (GHG) reduction goals
- Positioned the ORNL campus to reduce energy intensity by at least 30% by 2015
- Completed four additional High Performance Sustainable Buildings (HPSBs)
- Achieved water reduction of 35% to date, exceeding the FY 2020 goal
- Surpassed the goal for electric use by achieving 91.7% of individual building metering goal
- Achieved 78.6% of the construction and demolition diversion rate for debris, surpassing the 50% goal
- Received seven external awards and certificates (e.g., from the DOE Sustainability Performance Office [SPO], Tennessee Chamber of Commerce and Industry, and East Tennessee US Green Buildings Council)

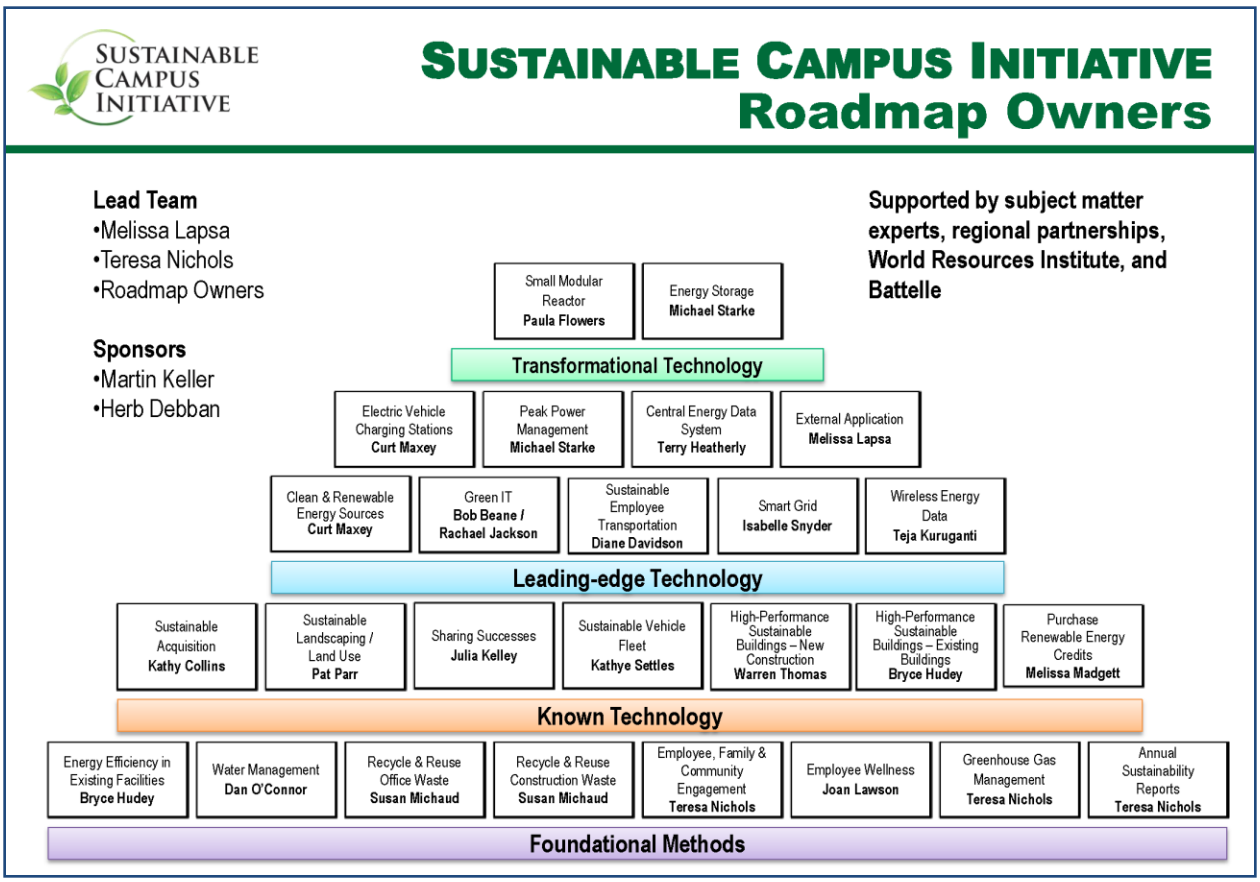


Figure 1. Roadmap owners' project pyramid, part of the ORNL Sustainable Campus Initiative roadmap.

Table 1 summarizes ORNL's FY 2012 performance and planned actions to attain future goals. ORNL continues to acknowledge that a major challenge exists in meeting the Scope 1 & 2 GHG emissions reduction goal of 28% based on the increase in expected energy consumption demands in support of programmatic growth. However, as a result of operational improvements and management vision, ORNL is well positioned **to reduce energy intensity by at least 30% by 2015**, supporting the GHG emissions reduction goals. Other strategies to meet the GHG reduction goals are described throughout this report and summarized in Section 1.9 (GHG Scope 3) and Section 1.10 (GHG Scope 1 & 2).

ORNL's goal is to reach benchmark levels of sustainability on campus by 2020 (and in many cases earlier) in a wide range of areas, including

- Facilities and Land
- Utility Infrastructure (including the Central Energy Data System and smart grid)
- Transportation
- Low-Emission Power Generation
- Employee Engagement
- Systems
- Waste Reduction
- Transformational Technologies (Innovation)
- Greenhouse Gas Management

While the above-mentioned strategies will be deployed at ORNL to advance site sustainability, ORNL will, in parallel, demonstrate transportability. Operations and research staff will work in tandem to advance energy and environmental innovations and solutions to stakeholders worldwide.
Specific innovative projects include, but are not limited to, the following:

- Biomass Steam Plant (operational status reached in July 2012)
- Pursuit of a small modular reactor (SMR)
- Continued installation of solar-assisted electric vehicle charging onsite and across the state of Tennessee
- Integrated Central Energy Data System
- High performance sustainable buildings
- Green gas onsite generation
- Expanded telework program
- Regional Sustainability Process
- Expanded solar photovoltaic (PV) installations
- Pursuit of small energy pumped storage
- Third Annual Sustainability Summit

Table 1. Summary of ORNL Site Sustainability Plan attainment of DOE sustainability goals

SC/SSPP/ OMB Goal	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
Goal 1: Greenhouse Gas Reduction and Comprehensive Greenhouse Gas Inventory				
1.1	Energy Intensity Reduction 30% by FY 2015 from a FY 2003 baseline.	In FY 2012, ORNL achieved a reduction of 30.1%, currently on track to reach the 30% goal by FY 2015.	Ongoing energy audits in progress will identify energy conservation projects to maintain the 30% goal.	**Low:** Goal was obtained in FY 2012. If additional projects are not implemented due to budget issues, the outlook and risk of attainment could change.
1.2	7.5% of annual electricity consumption from renewable sources by FY 2013 and thereafter (5% FY 2010–2012).	In FY 2012 ORNL supplemented ongoing activities by procuring 31,829 MWh of REC from Wind Resources, plus Green Power from TVA to offset on-site production yielding 6.2% of all power, meeting the goal for FY 2012. Onsite renewables solar power is 0.046% of ORNL total electrical consumption.	Several renewable energy projects are under review for consideration, and while some are not life-cycle cost-effective, other funding and purchasing options are being discussed. Investigating additional onsite generations such as PV and green gas generation.	**High:** Budget constraints in FY 2013 and beyond may limit funds needed for on-site renewable energy projects without partnering agreements. ORNL power consumption is projected to increase significantly, so achieving the goal will be increasingly difficult.
1.3	SF_6 Reduction	The SF_6 process loss in FY 2012 is calculated at 18,429 $MTCO_2e$ (from releases of 1,700 lb), a 32% reduction from the FY 2008 baseline of 27,102 $MTCO_2e$ (from releases of 2,500 lb), and an even greater improvement	All ORNL SF_6 process losses result from operation of the HRIBF tandem accelerator. Effective surveillance and maintenance, ongoing system upgrades, and efficient	**Medium:** Risk of non-attainment of the GHG reduction goal is not easy to determine due to the unknown programmatic status/funding for the HRIBF facility.

SC/SSPP/ OMB Goal	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
		from the FY 2011 estimate of 168,828 $MTCO_2e$ (an 84% year-over-year reduction).	future operations will minimize future SF_6 losses.	
1.4	Individual buildings metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015).	Due to an aggressive site Metering Program, ORNL is largely in compliance with DOE mandates by achieving 91.7%, surpassing the goal for electrical use. The balance of the electrical metering is anticipated to be completed by the end of FY 2015. The remaining systems are progressing toward full compliance.	Continued implementation of metering plan, in order to finalize compliance with respect to metering of all commodities. Goals have been met in respect to natural gas, chilled water, potable water, steam, and data center requirements.	**Low:** Although operating budgets in FY 2012 and beyond have limited special funding for implementation of metering projects, ORNL has very little additional work needed to comply with the goal. Remaining meter installations are dependent upon synchronization with outage scheduling.
1.5	Cool roofs – all new roofs must meet Cool Roof standards and have thermal resistance of at least R-30.	In FY 2012, ORNL completed approximately 60,000 square feet in new cool roofs.	All new construction and renovated facilities will employ cool roof technologies.	**Low:** ORNL's Facilities Development Division standards and processes have been implemented that will assure continued use of cool roof technologies.
1.6	Training to ensure that facility energy managers can demonstrate the core competencies for facility managers.	Energy Efficiency Manager is a Certified Facility Manager and Certified Energy Manager. Complex Facility Managers were trained in environmental, safety & health topics and other Complex specific topics as required.	Identify functional core competencies as DOE-specific FBPTA guidance is issued. Analyze training needs for facility managers related to energy management and provide training opportunities.	**Medium:** Budget constraints could limit ability to obtain external training. Recent reductions in staff could impact scheduling of courses.
1.7	Net Zero energy in new or major renovation facilities.	New design work will comply on defined schedule.	New design work will comply on defined schedule.	**Medium:** Cost of design could affect non-attainment.
1.8	Evaluate 25% of 75% of facility energy use over four-year cycle.	On target: The JCI ESPC evaluation in FY 2008 provided the first 100% audit of the ORNL campus.	In FY 2012, completed the four-year cycle of the plan developed in FY 2009 to evaluate at least 25% of the covered facilities annually.	**Low:** For FY 2013 and beyond audits will be conducted using a combination of cost effective approaches.
1.9	13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline.	FY 2012: Scope 3 estimate is 44,328 $MTCO_2e$. Challenge to meet target. Overall Scope 3 grew by 8%. While employee commutes (-6%), business air travel (-9%) and business ground travel (-9%) have improved, a 31% growth in T&D losses limits the overall performance.	Focus areas are employee commute and telework to ensure progress toward Scope 3 reductions that are related to employee engagement. T&D losses T&D losses will be minimized by a new substation (operational FY15) that will reduce the T&D losses on the	**High:** Overall risk of non- attainment of 13% reduction is high due to T&D losses from TVA power, as consumption grew by 46% from the baseline to FY 2012 and is expected to increase by 174% by FY 2020 (from the FY 2008 baseline).

SC/SSPP/ OMB Goal	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
			medium voltage distribution system. Although reduced, T&D losses will rise in proportion to electrical energy used.	
1.10	28% Scope 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline.	FY 2012 Scope 1 estimate is 61,257 $MTCO_2e$, a decrease of 32% from FY 2008. With Renewable Energy Credits (RECs) in FY 2012 to avoid GHG emissions, the Scope 2 estimate is 295,077 $MTCO_2e$, an increase of 18% from FY 2008. A FY 2012 Scope 1 and 2 combined estimate of 356,334 $MTCO_2e$, is an increase of 5% from the baseline year of FY 2008.	**Scope 1** reductions are on target due to ECM efforts and the results from the ESPC implementation. The Biomass Steam Plant reached operational status in July, 2012. **Scope 2** reductions represent more of a challenge due to growth in electricity demands for mission critical facilities.	**Scope 1: Low:** ESPC and Biomass Steam Plant implementation are keys to attainment. **Scope 2: High:** Risk of non-attainment of 28% reduction is high due to growth in electricity usage. Consumption grew by 45% from the FY 2008 baseline to FY 2012 and is expected to increase by 174% by FY 2020. Overall Scope 1 & 2 reduction goals are not attainable without the implementation of transformational energy projects (innovation) such as the SMR technology as detailed in section 8.1.
Goal 2: Buildings, HPSB, ESPC Initiative, Regional and Local Planning				
2.1a	15% of existing buildings greater than 5,000 gross square feet (GSF) are compliant with the Guiding Principles (GPs) of HPSB by FY 2015.	Four additional existing buildings achieved HPSB status in FY 2012 for a total of 17; currently on track to reach goal of 15% by FY 2015.	17 of the 22 required buildings at ORNL have achieved HPSB status by end of FY 2012; currently on track to reach goal of 15% (22 buildings) by FY 2015.	**Medium:** The operating budgets in FY 2013 and beyond may limit special funding for implementation of necessary facility modifications, which could impact the goal.
2.1b	All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs.	To date, 15 new facilities have been LEED certified. Four are LEED Gold, 2 more are pending LEED Gold. Two buildings are LEED Silver. One additional building will be constructed to LEED Gold by 2015.	*All* new construction is specified for LEED Gold as a routine part of the facility development process.	**Medium:** Cost constraints FY 2013 and beyond may limit funding for the implementation of necessary facility design and construction requirements, which could impact meeting the goal.
2.2	ESPC Initiative	Non-quantitative goal	ORNL continues to have planned discussions with Site Office. These include accomplishment of ECMs from CEDR and possible onsite generation projects.	**High:** Although informal discussions have been held with ESCOs, no notice of opportunity has been submitted.

SC/SSPP/ OMB Goal	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
2.3	Regional & Local Planning	Non-quantitative goal	Specific regional and local planning activities will be considered based on feasibility, cost, and potential impact.	**Medium:** ORNL has a strong network of stakeholders who are engaged in local and regional planning.
Goal 3: Fleet Management				
3.1	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline.	On target: 38% of alternative fuel was consumed in 2005; increased to 75.5% alternative fuel consumption in 2012.	Continue to use alternative fuels and continue to educate drivers about the importance of using alternative fuels in Flex Fuel vehicles to meet the Goals.	**Medium:** An interruption in the availability of alternative fuels is the biggest risk, and ORNL has little control of fuel markets. Availability has been an issue at certain times in the past.
3.2	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline.	The target for meeting this goal should be at a 14% reduction for FY 2012. In FY 2012, ORNL had achieved a 21% reduction.	Continue to use alternative fuel. Continue to ensure biodiesel integrity is maintained.	**Medium:** If the availability of alternative fuels is interrupted, then Flex Fuel vehicles could be forced to use gasoline.
3.3	100% of light duty vehicle purchases must be AFVs by FY 2015 and thereafter.	Light duty vehicle purchases in FY 2012 were 100% AFVs.	Continue to purchase AFVs from GSA schedules as funds and approvals are available.	**Low:** All vehicles purchased will be AFVs. However, the cost of GSA schedule electric vehicles remains too high to consider.
3.4	Submit Right-Sizing the Fleet Management Plan for approval by Dec. 31, 2012. Identify mission critical/non-mission critical vehicles by December 31, 2012.	Right-Size Fleet Plan will be submitted by deadline.	Prepare the plan based on provided directions.	**Low:** Right-Size Fleet Plan will be completed as established in Goal.
Goal 4: Water Use Efficiency and Management				
4.1	26% potable water intensity (G/GSF) reduction by FY 2020 from a FY 2007 baseline.	Significant savings were realized in FY 2012 that resulted in a water intensity of 114 G/GSF, which exceeds the FY 2020 goal. (A reduction of 35% to date).	Additional savings are planned that include eliminating additional once-through cooling and repair of leaks in the water distribution system.	**Low:** Current performance of 114 G/GSF exceeds the FY 2020 water intensity goal of 130 G/GSF as established as the baseline.
4.2	20% water consumption reduction of ILA water by FY 2020 from a FY 2010 baseline.	No industrial, landscaping, and agricultural (ILA) water use at ORNL.	No ILA water use at ORNL.	No ILA water use at ORNL.
Goal 5: Pollution Prevention and Waste Reduction				
5.1	Divert at least 50% of nonhazardous solid waste, excluding	A 33% diversion rate was achieved in FY 2012. While less than the target, this	Continue mediation measures and process improvement in FY 2012	**Medium:** The operating budget in FY 2013 and beyond may limit

SC/SSPP/ OMB Goal	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
	construction and demolition debris, by FY 2015.	represents a significant improvement in the past year.	to assure attainment.	funding for the implementation of a suitable program to ensure attainment of goals.
5.2	Divert at least 50% of construction and demolition materials and debris by FY 2015.	ORNL's diversion rate for construction and demolition debris is greater than the 50% goal for FY 2012 (78.6%).	Continue process improvements to meet or exceed the goal by FY 2015. Additional focus will be place on segregation of waste.	**Low:** Implementation of work processes such as progressive subcontract procedures and better waste segregation to ensure compliance with goals.
Goal 6: Sustainable Acquisition				
6.1	Procurements meet requirements by including necessary provisions and clauses (Sustainable Procurements / Biobased Procurements)	100% of all procurement transactions in FY 2012 (excluding purchase card transactions) contained terms and conditions that invoke requirements for sustainable acquisitions.	Procurements transactions will continue to include standard UT-Battelle terms containing sustainable acquisition requirements. Will investigate scenarios to improve the performance of purchase card transactions.	**Low:** Standard work processes and business flow procedures ensure inclusion of required provisions in standard procurements. Opportunities will be pursued to improve purchase card performance with goals.
Goal 7: Electronic Stewardship and Data Centers				
7.1	All data centers are metered to measure monthly power utilization effectiveness (PUE) (100% by FY 2015).	All data center equipment is metered; plans are developed for additional BTU meters on chilled water lines.	Install the remaining BTU meters in FY 2013 so that PUEs can be calculated more directly and more accurately.	**Low:** All equipment is currently metered and additional system metering capability is planned.
7.2	Maximum annual weighted average PUE of 1.4 by FY 2015.	The calculated PUE value at year end FY 2012 is 1.29 for the Building 5300 data center and 1.26 for Building 5600.	See goal 7.1 above: It is expected that with the addition of additional system meters, and with continuous improvement, the PUE calculations will be more accurate.	**Low:** The PUEs can be calculated now; however, some indirect calculations need to be made. New meters and storage equipment will help to stabilize the results so the goals will consistently be met.
7.3	Electronic Stewardship – 100% of eligible equipment with power management actively implemented and in use by FY 2012.	All eligible PCs and monitors are actively power-managed.	Final implementation of the upgrade to the Verdiem server to include Macintosh systems will be complete in FY 2013.	**Low:** Continue to actively ensure all eligible computing equipment is power managed.
Goal 8: Innovation & Government-Wide Support (Non-quantitative Goal)				
8.1	The goal for innovation at ORNL is to help DOE maintain US global leadership in science, engineering,	ORNL continues to be actively engaged in regional and local planning for transportation options as well as outreach activities	Specific innovative projects detailed in section 8.1 will be considered based on feasibility, cost, and	**Medium:** ORNL has a strong network of stakeholders who are engaged in local and regional planning.

SC/SSPP/ OMB Goal	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
	and energy management.	for the enhancement of sustainability effort in the entire southeast region.	potential impact.	Opportunities for regional action continue to be pursued.

II. Performance Review and Plan Narrative

Goal 1: Greenhouse Gas Reduction and Comprehensive Greenhouse Gas Inventory

1.1 Energy Intensity Reduction

DOE Goal: 30% Energy Use Intensity (EUI) Reduction by FY 2015 from a FY 2003 baseline.

Performance Status

ORNL continues to make steady progress toward meeting or exceeding the goal of reducing energy intensity by 30% by FY 2015 from a FY 2003 baseline (Figure 2). This is accomplished through continued construction of new energy-efficient facilities, re-purposing existing facilities to better align with mission and resources for effective operations, and demolition of inefficient legacy facilities. Aggressive energy reduction activities in current facilities will be combined with ongoing audits and the Energy Conservation Measures (ECM) program, new efforts in building commissioning, benchmarking energy consumption, and best management practices. As demonstrated in Figure 3, over the past decade the footprint of ORNL's offices and laboratories has increased 50%, accompanied by a 7.3% decrease in energy consumption (with the exclusion of biomass consumption in the EUI calculation).

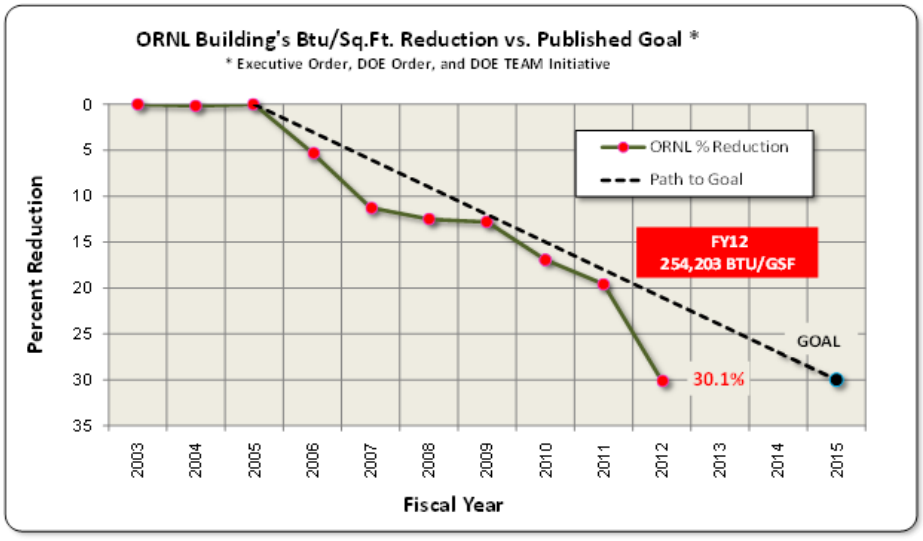


Figure 2. Summary of Energy Intensity Results and Progress toward Goal

The Energy Savings Performance Contract (ESPC) included several energy conservation measures that have been implemented. Two ECMs were not included in the EUI calculation for FY 2012 due to the timing of their effective completions. Additional savings from these ECMS are expected to further improve the EUI in FY 2013 and beyond.

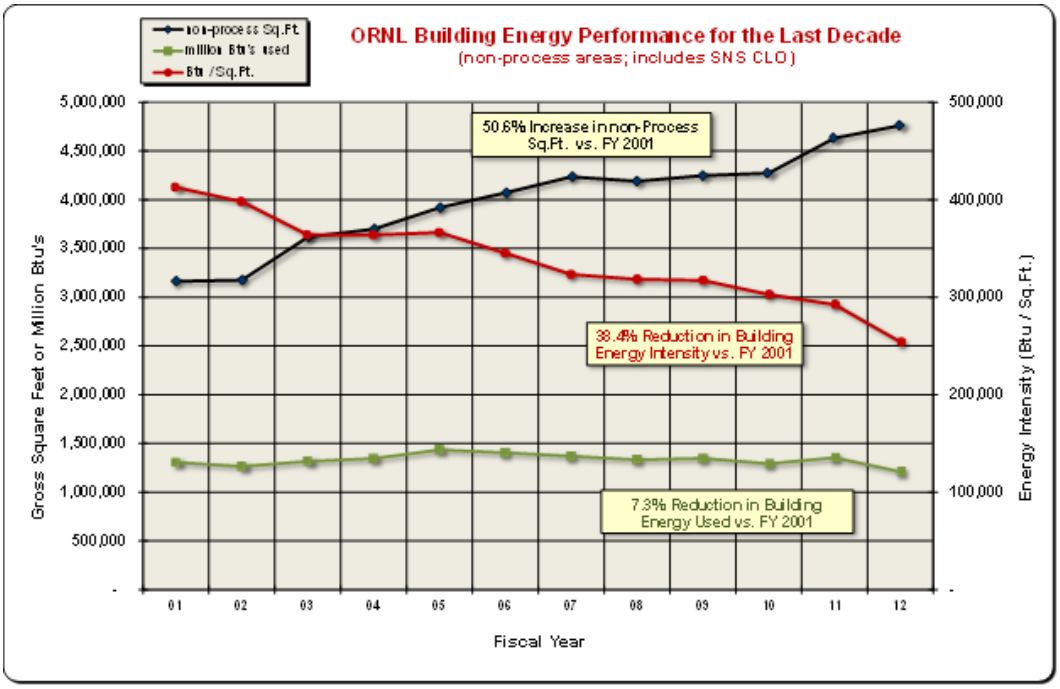


Figure 3. ORNL building energy performance for the last decade.

Based on FY 2012 data, Buildings Category energy usage at ORNL is 1.210709×10^{12} BTUs (not including ORNL's excluded facilities as defined by the Energy Policy Act of 1992 [EPACT] or the biomass fuel consumption per DOE Headquarters' instruction). Given the area of 4,462,777 gross square feet (GSF) of energy-consuming (EC) buildings, trailers, and other structure/facilities identified in the Facilities Information Management System (FIMS), the FY 2012 calculated energy intensity is 254,203 BTUs/GSF, which represents a 13.5% reduction compared to FY 2011.

When compared to the EPACT 2005 baseline year of FY 2003, ORNL has experienced a 30.1% reduction to date, exceeding the FY 2015 goal of a 30% reduction in EUI. The FY 2012 current performance EUI is based on the FIMS Building EC GSF of 4,423,480 GSF plus the Other Structure/Facilities' Building EC GSF of 339,297 GSF for a total of 4,462,777 GSF.

Plans, Actions, and Projected Performance

At ORNL, the ESPC with Johnson Controls, Inc. (JCI) is the primary mechanism for achieving the goals established to meet the EPACT directives. A Delivery Order with JCI was awarded in July 2008 and formally accepted in July 2012. The ESPC/ECMs included steam system decentralization, lighting upgrades, water conservation, building management system improvements, mechanical equipment upgrades, and a biomass steam production system. While the majority of the ECMs were completed for inclusion in the FY 2012 EUI calculations, a few outstanding items remain.

One significant ECM, the Biomass Steam Plant, has been operating since July 2012, so a full year's benefits have not been realized in the EUI calculation for FY 2012. Additional energy savings are expected with a full year of operations in FY 2013 for an improved EUI.

One component of the steam de-centralization ECM would de-energize the steam distribution line to the Melton Valley Steam Plant (MVSP), but this was not completed until the fall of 2012. The MVSP has been operating without assistance from the Biomass Steam Plant since that time, so the energy savings from steam distribution losses have not been realized in the EUI calculations for FY 2012. The steam distribution line will remain in place (though de-energized) during the FY 2013 heating season as a redundant system for the MVSP and the energy savings from the steam distribution line are expected to be realized in FY 2013. Once the MVSP completes its first heating season, the removal of this steam distribution line will be re-evaluated.

In recent years, additional ECMs, not addressed by the ESPC, have been implemented to further reduce energy usage. These additional measures include ENERGY STAR® assessments and related actions; improvements in heating, ventilation, and air conditioning (HVAC) equipment; lighting improvements; replacing motors with more efficient units; and improving the efficiency of the steam distribution system.

The energy audit program in response to EISA Section 432 audits began in FY 2009, and the first four-year cycle concluded in FY 2012 covering all of the ORNL campus square footage to complete the task. Potential ECMs developed during that evaluation are being vetted to determine which actions are most cost-effective and complementary to the Laboratory mission and existing building use and plans. Once this evaluation is completed, additional audit-related ECMs will be identified for FY 2013 implementation and available funding. These will be identified in the accompanying Consolidated Energy Data Report (CEDR).

ORNL continues to review its legacy buildings for demolition when appropriate and to consolidate activities into newer, more energy-efficiency buildings. As new buildings are considered for development, high performance sustainable design principles are given a high priority, including the consideration of Leadership in Energy and Environmental Design (LEED) Gold Certification for large facilities and the Guiding Principles. Using this approach, increases in the ORNL footprint become, by default, energy efficient, sustainable, and mission-ready.

Additionally, as described elsewhere in this report, projects are being evaluated and will be included in the CEDR if appropriate.

As noted, since the baseline year of FY 2003, ORNL has reduced energy intensity by 30.1%. Based on this success and other measures that will be implemented, ORNL anticipates an energy intensity reduction higher than 30% by FY 2015. Planning began in FY 2012 to address energy consumption in High Energy Mission-Specific Facilities at ORNL. These facilities include the Spallation Neutron Source (SNS), Center for Nanophase Materials Sciences (CNMS), High Flux Isotope Reactor (HFIR), Holifield Radioactive Ion Beam Facility (HRIBF), and the facilities hosting high performance computing. In the past these facilities have been given exclusions from the energy intensity reduction goals, in recognition of the fact that the science mission energy loads in these facilities were difficult to modify without directly impacting the mission. The federal GHG target goals that were recently established as a result of

EO 13514 do not allow for exclusion of these high energy facilities, however. Since these critical loads must be included in reduction goals, ORNL will use FY 2013 to develop a process that will accommodate energy-saving projects in these facilities, while continuing to acknowledge that

- Mission critical outcomes must be maintained.
- No funding mechanism for "self-financing" is in place.
- Due to operational and research complexities, the planning horizon for projects affecting these facilities represents a long-term commitment.

A multi-organizational team is developing a process for vetting potential energy-saving projects, identifying funding mechanisms, and integrating the projects within the planning horizon of the respective facilities. Funding remains the largest challenge since these buildings pay for their utilities directly as opposed to having a variance set aside.

In summary, Figure 3 shows that over the past decade, the footprint of ORNL's offices and laboratories has increased 50% with a 7.3% decrease in energy consumption, with the exclusion of biomass impact from the EUI calculation. ORNL has succeeded in reducing the energy intensity in those facilities by approximately 39%. ORNL is dedicated to continuing this success.

Barriers

At ORNL, dedicated efforts continue to reduce energy consumption in energy-consuming buildings, trailers, and other structures/facilities as identified in energy audits, commissioning, and preventive maintenance activities to meet or exceed the 30% reduction in energy use intensity.

While ORNL has achieved a 30.1% reduction, exceeding the goal ahead of FY 2015, ORNL must remain vigilant to maintain this EUI reduction with the projected expansion of the ORNL missions.

As the low-hanging fruit from the ECMs are implemented over the next few years, the next level of ECMs may become more complex and more costly to implement. Funding will be required to support this more challenging effort to continue to meet the reduction goal. A waterfall chart of EUI improvement that demonstrates history and future projections for the improvement plan is shown in Figure 4.

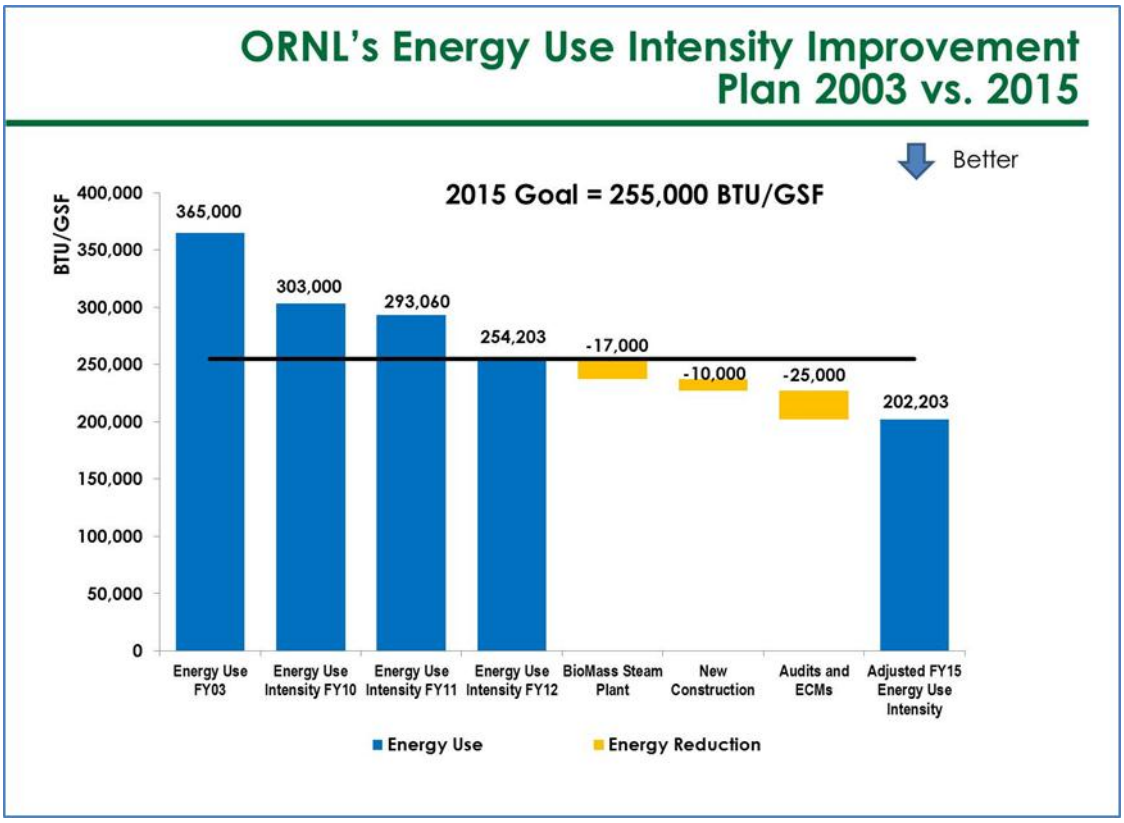


Figure 4. Energy use intensity improvement plan (FY 2012 EUI is calculated at 254,203 BTU/GSF).

1.2 Renewable Energy Consumption

DOE Goal: 7.5% of annual electricity consumption from renewable sources by FY 2013 and thereafter (5% FY 2010–2012).

Performance Status

ORNL plans and actions are moving toward achievement of the DOE Order 436.1 goal of providing 5% of the site's electrical consumption from renewable sources by FY 2012, and 7.5% thereafter. Until recently, renewable energy (RE) generation at the Laboratory was embedded in small research-oriented photovoltaic (PV) systems, but that picture has changed markedly. A 5 kW PV array was brought on line in early FY 2008, and a 50 kW PV array began providing electricity in FY 2009. The new 50 kW PV array for the solar-assisted vehicle parking went on line in FY 2011 and can also be used to offset the power used for 25 electric vehicle charging stations. A 30 kW roof-top PV array also contributes to ORNL's on-site generation capabilities.

Currently, ORNL has identified multiple sources of RE to offset an electrical consumption of 525,218 MWh. Consider the following.

- The electricity produced on-site from the three solar arrays (67.7, 6.6, and 51 MWh) account for approximately 0.023% of ORNL's electricity, or 0.046% due to the on-site double bonus generation.

- ORNL participates in the Tennessee Valley Authority's (TVA's) Green Power Switch Program by purchasing 675 MWh of renewable energy (0.13%), continuing the 10-year partnership as TVA's first industrial participant.
- ORNL purchased 31,829 MWh of Renewable Energy Credits (RECs) from wind resources (6.06%).
- The total renewable energy of 32,747 MWh exceeds the 5% FY 2012 goal at 6.23%.

As an additional benefit of meeting the renewable energy goals, energy generated from approved renewable means, either on-site or purchased from off-site vendors, can be allocated to new buildings, or significantly renovated buildings, to assist in achieving LEED certifications for the rating desired. This will ensure that new buildings/renovations will have their dedicated renewable resource in case the FY 2013 funding is limited and would not permit a lab-wide REC purchase.

For example, ORNL purchased 1,829 MWh for dedicated use at a specific building for LEED certification. The additional purchase of RECs can be used to allocate site-wide the prorated RECs to the remaining buildings.

Plans, Actions, and Projected Performance

A wide variety of potential RE-sourced energy options are currently under review. The following is a brief summary.

- Utility-Scale Solar Photovoltaic (USS-PV) – ORNL is evaluating options for a business case procurement of 1–2 MW DC generation and involvement of TVA, our electrical provider.
  - Third-party development, equipment leases, and Purchase Power Agreements will need to be considered.
- On a smaller PV scale, a TVA solar PV grant is anticipated in response to EPA actions. ORNL is maintaining communications with TVA, with an update on the status of the grant program anticipated in December. The potential project under this grant could consist of a solar array of 100–500 kW, with benefits to TVA. Competition for this grant is expected to be very strong.
- Green Gas Purchases – ORNL is evaluating the purchase options and economic impacts of green gas needed to power a 2 MW generator on site.
  - ORNL has a very strong interest in Green Gas Generation. This represents ORNL's best hope of meeting renewable electricity mandates without purchasing RECs.
  - A potential project would be to partner with the 7000 area revitalization to include infrastructure development to support the green gas generator and utilize the waste heat for the thermal energy park that is envisioned as part of this project. This co-generation system (power plus heating) would be an enhancement to the 7000 area revitalization.
  - This option includes purchasing pipeline delivered "green gas," wherein a producer has cleaned landfill or other renewable methane sources to pipeline quality and injected them into the natural gas distribution system. ORNL would purchase natural gas with the intent to quantify the electricity attributable to green gas combustion
  - Energy-efficient options include utilization of engines developed under DOE's Advanced Reciprocating Engine Systems (ARES) program that achieves greater than 42% electrical efficiency in power generation from the waste heat. ORNL has been a major research contributor to the ARES program since its inception in 2000.

- Renewable Energy Certificates – ORNL will periodically monitor the REC open market and consider purchases if necessary to meet the renewable goal.
  - ORNL may use multiple purchases throughout the year based on energy consumption projections and REC pricing to allow strategic purchasing of RECs to best fit the 7.5% goal for FY 2013.
  - ORNL also reviewed third-party solicitations from the Western Area Power Administration (WAPA) and the Defense Logistics Agency (DLA), but utilized ORNL's staff for the procurement in FY 2012.
  - RECs are likely to be considered in the short-term until a cost-effective, feasible solution for on-site electrical generation can be developed and implemented. ORNL's primary strategy is to developing on-site capabilities prior to considering other options.
- Small Modular Reactor (SMR) – ORNL is supporting a strong regional commitment to clean energy, facilitated by the potential construction of a SMR that could be built by TVA with prospective financial support (possibly clean energy certificates) provided by DOE-HQ, DOE-OSO, and/or ORNL. DOE's announcement to invest in SMR design, commercialization, and location in Tennessee is encouraging news to ORNL.

Barriers

A wide variety of potential RE-sourced energy options are currently under review and are subject to funding opportunities for the above capital-intensive projects.

Solar resources demand a large amount of space, five acres per MW DC, and cost approximately $5/W. Even using the double credit bonus to reduce the amount of renewable energy (25,000 MWh for FY 2013), a solar project would require about $91.5 million and over 90 acres of acceptable space.

Procurement arrangements for the green gas purchases will need to be confirmed before the green gas generation project could begin. The 7000 area revitalization efforts will need to be coordinated with the generator project to maximize benefits to both activities.

In addition to funding, the extension of the term permitted for the Purchased Power Agreements (PPAs) would be beneficial in negotiating long-term partnerships for such renewable energy projects.

1.3 SF_6 Reduction

DOE Goal: As an important component of Scope 1 GHG emissions, 28% reduction in SF_6 emissions by FY 2020 from a FY 2008 baseline. Discuss fugitive emissions, plans to reduce emissions and/or expected increases along with net impact. SF_6 process facilities to have a capture program in place by September 2012.

The Holifield Radioactive Ion Beam Facility (HRIBF), located in Building 6000, has served as a nuclear physics facility for research with radioactive ion beams since 1996 and maintains the largest inventory of sulfur hexafluoride (SF_6) gas at ORNL. SF_6 insulating gas is required for the safe operation of the HRIBF 25-million-volt tandem electrostatic accelerator to prevent electrical discharge from the high-voltage terminal and accelerating column to the pressure vessel.

The HRIBF facility was originally designed with a SF_6 "capture" system. When the SF_6 is in gaseous phase during accelerator operation, it is recirculated through the accelerator pressure vessel. When maintenance inside the accelerator pressure vessel is required, the SF_6 is compressed to the liquid phase and transferred to three storage (capture) pressure vessels in Building 6005. Following maintenance activities, the gas is vaporized and returned to the accelerator pressure vessel. Thus the system continuously captures and reuses the inventory of SF_6.

Performance Status

SF_6 is a key contributor to ORNL's Scope 1 GHG emissions inventory. It will be mandatory to actively manage SF_6 emissions in order to meet DOE's overall reduction goal of 28% for Scope 1. An overall awareness of the global warming potential (GWP) of SF_6 has resulted in a more cautious environment in the requisition and purchase of this potent GHG. ORNL is committed to evaluating potential process and purchasing improvements that will result in substantial SF_6 emission reductions.

The SF_6 inventory at the end of FY 2012 was approximately 209,800 lb. Losses during the year totaled 1,700 lb, which was less than the facility baseline of 2,500 lb/year as established as part of the ORNL FY 2008 GHG baseline analysis. Normal process losses vary from year to year because the number of SF_6 transfer cycles from the tandem to storage and back varies from year to year. Losses during a typical transfer cycle are significantly larger than losses during a comparable period while SF_6 is resident in the tandem. In FY 2012, there were only two gas transfer cycles, and all losses were normal process losses.

The SF_6 process loss in FY 2012 is calculated at 18,429 $MTCO_2e$ (from releases of 1,700 lb), a 32% reduction from the FY 2008 baseline of 27,102 $MTCO_2e$ (from releases of 2,500 lb).

Plans, Actions, and Projected Performance

As of the end of FY 2012, HRIBF tandem accelerator operation is not currently funded by the DOE Office of Nuclear Physics (DOE-NP), but the accelerator is being maintained in a safe and secure condition as future options for the HRIBF accelerators and experimental systems are explored. All surveillance and maintenance activities associated with the tandem accelerator and the SF_6 gas handling system continue as normal. In addition, facility staff members continually evaluate the potential for further loss reductions, including simplification of the gas handling system, refurbishment of compressors, and elimination of potential single-point failures. Purchases of SF_6 for non-process uses remain small relative to the process use at HRIBF, and the non-process purchases continue to decline as a result of overall awareness regarding SF_6 impacts.

Barriers

Risk of non-attainment of the GHG reduction goal for SF_6 is difficult to determine at this time due to the unknown programmatic status/funding for the HRIBF facility.

1.4 Metering for Individual Buildings

DOE Goal: Individual buildings or processes metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015)

Performance Status

FY 2012 percentages calculated as of 11/20/2012:

- 91.7% electrical
- 7.2% steam
- 95.8% natural gas
- 65.0% chilled water

ORNL's specific status with respect to each requirement and/or goal is as follows.

- "Meter at a building level 75% of electricity use at each site by October 1, 2011, (all electricity use at stand-alone buildings and 75% of electricity used at multi-building campuses), working toward a goal of 90% by October 1, 2012."
  - ORNL is currently metering in excess of 75% of building level electricity use.
  - At an achievement rate of 91.7%, ORNL has exceeded the October 1, 2012, goal of metering 90% of building electrical use.
  - ORNL is metering 100% of data centers, with significant submetering within data centers as well.
- "Meter at a building level 10% of natural gas, steam and chilled water usage at each site by October 1, 2011, (all resource use at stand-alone buildings and 75% of resources used at multi-building campuses), working toward a goal of 90% by October 1, 2015."
  - ORNL is currently metering natural gas and chilled water at well above the required 10% level for October 1, 2012.
  - ORNL is metering all steam output, as well as limited metering of steam usage.
  - ORNL is on target for achieving 90% metering on these commodities by 2015.
- "Meter 40% of agency data centers by October 1, 2011, working toward a goal of 100% by October 1, 2015."
  - ORNL is currently metering 100% of data centers, with significant submetering in data center applications, placing the site in compliance with the 2015 mandate.
  - In addition, any new buildings will include metering so this mandate is met.

Plans, Actions, and Projected Performance

At the end of FY 2012, additional funds were made available for electricity meters. Approximately 200 devices were procured for three purposes:

- Submetering for upgrades to the computational facilities (30 devices)
- Medium voltage replacements and additions (120 devices)
- Replacements for manual meters and new metering and submetering at the facility level (60 devices)

At the same time, additional funds were made available for enhancements to the Central Energy Data System. These enhancements were installed at the end of FY 2012. These enhancements as well as the majority of the meters will be installed in FY 2013. The meters in the computational facilities will be installed as part of the ongoing work as those facilities are brought on line and upgraded. The meters for the medium voltage installations will be installed as the circuits they affect are taken out of service for scheduled outages. In these two cases, the work is known, funds are available, and schedule is dictated by the system owners. In the case of the facilities metering, a schedule is under development, as well as budgets for funding consideration, which will be part of the facilities budget.

Potable water meters are also funded in FY 2013 and are discussed in that section. As part of the Sustainable Campus Initiative, additional funds were also made available for additional steam metering at the end of FY 2012, and those meters are also to be installed in FY 2013 as the budget and operational schedules allow.

Barriers

There are two major barriers to completion of these installations: funding and priority. As to the funding, as stated previously most of the funds for the computational facilities, utility medium voltage, and steam metering is on hand. The challenge will be securing funds for the installation of the new meters within the facilities, since that budget is somewhat fixed. As to the priority, limited craft resources and larger issues that must be resolved often push energy-related activities down on the prioritization. This can cause delays in meter installations. The need for scheduling outages for the work also causes delays, since a best practice would be to schedule a meter installation to coincide with an outage for other work.

1.5 Cool Roofs

DOE Goal: All new roofs must meet Cool Roof standards and have thermal resistance of at least R-30.

Ongoing in FY 2012, ORNL continues to enforce cool roof strategies for all new building projects, as well as for all re-roofing projects considered feasible and cost effective, both current and planned. Highly reflective roofing systems, green (planted) roof systems, and PV systems are among the approaches that are evaluated for each project. An insulation value of R-30 is the standard specification reflected in all engineering standards. Bi-annually, as part of the FIMS reporting, cool roof construction is updated and coordinated to ensure compliance with the DOE goals.

Performance Status

In FY 2012, ORNL completed 58,789 SF of cool roof construction, both new building and re-roofing projects. These include the new MAXLAB project, Building 4020, as well as two new research platform buildings for which the roofing system effectiveness will be studied by the Building Envelope Research Group of the Energy and Transportation Science Division.

Included in this section is a list of cool roof projects completed in FY 2012. Over 97% of new and re-roofed areas are being completed to meet either total or partial cool roof standards (see comment column). In special circumstances, engineering challenges have resulted in minor deviations from the

standard (such as elevator room roofs that will not accommodate additional insulation). Combined with previous cool roof installations in FY 2011 and earlier, the new Lab-wide total of cool roof technology is now just under 19% of all roofs as shown in Table 2.

Table 2. ORNL re-roofing and new roofs in 2012

Building Number	Cool Roof Area	Total Building Area	Comments
1061	3,473	3,524	Elevator room roof will not accommodate addl insulation.
1062	3,473	3,524	Elevator room roof will not accommodate addl insulation.
1507	3,473	3,524	Elevator room roof will not accommodate addl insulation.
1509	3,473	3,524	Elevator room roof will not accommodate addl insulation.
2008	4,390	4,726	Whole Body Count – Cool Shingles only. Roof details will not accommodate addl insulation.
4008	2,831	2,831	Parking canopy, full photovoltaic
4020	14,440	14,440	Total Cool Roof
5500A	3,523	3,523	Total Cool Roof
5510A	7,366	7,366	Total Cool Roof
6000B	4,948	4,948	Total Cool Roof
6012	5,705	6,707	Lower roof not re-roofed
AMSE	1,694	1,694	Solar House – Cool shingles only. Roof details will not accommodate additional insulation.
TOTAL 2012	**58,789**	**60,331**	**Over 97% of subject 2012 projects**
Lab-wide Totals	591,263	3,176,991	**19% of all roofs**

Plans, Actions, and Projected Performance

In FY 2013 and beyond, ORNL will continue to implement the advanced Standards of Practice we have developed—that is, master design criteria, standard specifications, basic ordering agreements, and project reviews—to enforce the installation of cool roofs for all new buildings and re-roofing of existing buildings. The Facilities Development Division will continue to coordinate with our roofing research division to ensure that we are implementing leading-edge systems and materials for our cool roof projects.

Barriers

ORNL's Facilities Development Division standards and processes have been implemented to ensure continued use of cool roof technologies.

1.6 Training

DOE Goal: Ensure facility energy managers can demonstrate the core competencies for facility managers.

Performance Status

In FY 2012, the ORNL Facilities & Operations (F&O) Directorate had a designated full-time Energy Efficiency Manager responsible for identifying and managing energy efficiency projects related to the ORNL facilities and related infrastructure. The energy manager that held the position is an International Facilities Management Association (IFMA) Certified Facility Manager (CFM) and an Association of Energy Engineers Certified Energy Manager (CEM). In November 2012, a new Energy Efficiency Manager was named. The new manager holds the CFM and CEM certifications, the Building Owners & Managers Institute (BOMI) Systems Maintenance Administrator (SMA) and Facility Management Administrator (FMA) designations, and the Green Buildings Council LEED Accredited Professional (LEED AP) Operations + Maintenance designation.

The CFM certification requires the demonstration of a working knowledge of all aspects of facilities management. This includes such topics as energy efficiency, environmental compliance, and project management. The FMA and SMA training curricula include courses related to energy efficiency, building systems, and emerging technologies.

F&O has a total of 11 IFMA CFMs in positions responsible for managing various aspects of ORNL facility operations and management (e.g., complex facility managers, division directors, and engineers). One complex facility manager holds both the CFM certification and the FMA designation. In addition, 12 F&O staff members responsible for supervising front-line work activities and managing projects hold the FMA. Eleven staff members hold the BOMI SMA designation.

In addition to these designation and certifications, F&O staff responsible for management of facilities attended courses and briefings in energy-efficiency-related topics. Managers completed all compliance training courses related to their environmental, safety, and health responsibilities.

Plans, Actions, and Projected Performance

- Identify functional core competencies as DOE-specific Federal Buildings Personnel Training Act (FBPTA) guidance is issued.
- Analyze training needs for facility managers related to energy management and provide training opportunities.

Barriers

Budget constraints could limit the ability to obtain external training. Recent reductions in staff could impact scheduling of courses.

1.7 Net Zero Energy

DOE Goal: Net Zero energy in new or major renovation facilities.

Performance Status

Planning efforts for net zero energy design in new construction have involved exploring research and design concepts that incorporate double-skin facades for new facilities. These concepts integrate well with the current net zero paradigms that model a combination of conservation measures and on-site renewable energy utilization. The double facades combine transparent outer glazing and photovoltaic glass units (PVGU) for the inner surface. The resultant design, when installed on new facilities, creates a ventilation cavity that can augment winter heating requirements and reduce solar gain, which lessens summer heat loads. In addition, the integral PVGU is a renewable energy source that provides on-site power generation.

1.8 Facility Energy Evaluations

DOE Goal: Each year, evaluate a minimum of 25% of 75% of Facility Energy Use over a Four-Year Cycle per EISA Section 432.

Performance Status

The energy audit program has made good progress, having completed another four-year cycle in FY 2012. Section 432 of the 2007 Energy Independence and Security Act (EISA) requires that 25% of 75% of facility energy use be audited each year, and repeated on a four-year cycle. Also, the evaluation by an energy service company (ESCO) for a site-wide initial proposal in preparation for an ESPC is acceptable as fulfilling this four-year requirement.

The JCI ESPC evaluation in FY 2008 provided the first 100% audit of the ORNL campus (Table 3). In FY 2009 a baseline for a second round of audits was established. Although not required at that time because of the JCI Initial Proposal, ORNL chose to proceed with this second round of audits beginning in 2009 to provide additional detail on potential ECMs that could be accomplished using in-house operating staff and funds. This also provided a ready list of ECMs in the event supplemental funds were provided, or in the advent of a later ESPC or utility energy service contracts. This second round of audits was completed in FY 2012. For this cycle, building-level audits have been conducted on 3.2 million SF of building space.

Table 3. ORNL energy audit results in annual SF and percentage of campus

Year	Annual SF	Annual % of Campus	Cumulative SF	Company
2008	3,195,365	100	3,195,365	JCI (ESPC)
2009	1,294,069	40.50	4,489,434	V3
2010	627,382	19.63	5,116,816	Keres/EMG
2011	470,563	14.73	5,587,379	Keres/EMG
2012	775,596	24.27	6,362,975	Keres/EMG

Because of the high energy mission-specific facilities (HEMSFs) at ORNL, the facilities that constitute 75% of the energy consumption are a very small number of the total building count on campus. ORNL determined this small number of facility audits, while achieving compliance with the requirement, did not meet the Lab's desire to have more detailed information on possible ECMs by building. Now that both the ESPC site-wide audit and the second round of audits for all buildings have been completed, Energy Management Program and Facilities Management staff have conducted an evaluation of each ECM identified in the audits and ranked them based on several criteria, both from an energy savings as well as maintenance and operations perspective. Also, these ECMs have been compiled and rolled up for reporting in the CEDR.

Plans, Actions, and Projected Performance

In FY 2013 and beyond, ORNL will take this body of work and fold it into a new round of audits. Many of the ECMs identified in the audits are low cost/no cost operational changes, so these will be used for consideration with facilities staff as they work on commissioning activities, either individually or as part of working toward LEED-EB, HPSB, or other goals. ORNL will also modify the audit process. Since we have a complete set of facility audits on hand, those will be used as a starting point for future activities. Also, more of the auditing will be conducted in-house as opposed to using outside auditing firms. Since the requirement is to audit buildings that comprise 75% of our energy consumption, and since recent audits exist for all buildings independent of their energy consumption, ORNL will right-size the number of buildings to be audited going forward. ORNL will focus its efforts on the more complex facilities for level 2 auditing and perform level 1audits, or table-top audits, on the smaller and less complex facilities. Also, the facility staff will be actively involved in both the building selection and the audit process, regardless of the level of audit being conducted.

Barriers

The auditing program has traditionally been a somewhat autonomous activity within the facilities. That is, an outside firm, either an ESCO or an energy auditing firm, has managed the process independently, working for the energy management staff, with the results then shared with the facilities staff. This approach was appropriate for the ESPC as part of the DOE TEAM Initiative, as well as during the first round of facility-specific audits. Now the Sustainable Campus Initiative is more imbedded in the day-to-day operations of the facilities, with activities like LEED-EB and HPSB becoming commonplace. Because of this transition it is now appropriate for the auditing function to be part of the responsibilities of the complex facility managers and the facility engineers, just like they have for the commissioning activities under LEED-EB and HPSB.

The challenge now becomes one of resource management. While little new funding will be required for this effort, the roles have changed for both the energy management and facilities staff. Before, the facility engineer was host and escort for the auditors, then performed the quality review of the product. In the new role, the facility engineer will be conducting the audits as well as any commissioning activities. The facility engineer will now decide which systems warrant review and provide documentation to the energy manager. In the future the energy manager will work with the facilities' staff to identify buildings to be reviewed each year, based on local needs. The energy manager will now be responsible for the documentation of the efforts of the facility staff, instead of hiring an audit firm. To accomplish this

successfully will require additional training and organizational development. It is assumed that this will be a multi-year effort to implement successfully.

1.9 GHG – Scope 3

DOE Goal: 13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline.

By definition, Scope 3 GHG emissions include those activities that ORNL can influence, but not control, by business processes alone. As with most federal workplaces, 99% of the Scope 3 emissions are attributed to the following activities at ORNL:

- Transmission and distribution (T&D) losses from purchased electricity
- Employee commute to the workplace
- Employee business air travel
- Employee business ground travel

In recognition of the need for sustainability in federal operations, the ORNL Sustainable Campus Initiative was launched in 2008. A key component of the initiative is the commitment to overall communications support aimed at employee engagement. Influencing the actions of employees, and their awareness of how those actions affect the carbon footprint of the organization, is one of the foundational methods to achieve a more sustainable future. The outreach and interaction processes are designed to focus efforts on the reduction of direct and indirect emissions in all actions. The initiative is communicated at all levels to management, employees, and contractors to encourage sustainable practices in the workplace and at home. All of these efforts raise awareness of the importance of energy savings and sustainable practices in the workplace, at home, and on the road.

Performance Status

In FY 2012 the total of all categories of Scope 3 GHG emissions is estimated at 44,247 $MTCO_2e$. Overall the Scope 3 inventory grew by 8% from the FY 2008 baseline, which is not on target for the DOE goal of a 13% reduction. The Scope 3 performance graph demonstrates that while employee commutes, business air travel, and business ground travel categories have improved, a 31% growth in T&D loss emissions limits the overall performance.

At the end of FY 2012, the ORNL employee workforce had experienced a 2% increase since the FY 2008 baseline year. The FY 2012 performance status (Table 4) shows a decrease in the Employee Commute and Business Air and Ground Travel categories. The 6% reduction in employee commute emissions is due to a strong engagement with employees, management, and regional resources aimed at reaping the benefits of carpooling and alternative work arrangement. The 9% reduction in Business Air and Ground Travel is due to a better awareness of the benefits of conservative travel, improved teleconferencing tools, and adaptation of European emission factors (determined by the federal GHG working groups to represent more accurate travel emissions than the previous EPA factors).

Table 4. ORNL Scope 3 GHG emissions performance status

Scope 3 GHG Emissions	FY 2008	FY 2012	Increase (Decrease)	(% +/-)
T&D Losses	16,429	21,499	5,070	31%
Employee Commute	16,193	15,177	(1,016)	-6%
Business Air Travel	7,204	6,545	(695)	-9%
Business Ground Travel	1,169	1,060	(109)	-9%
Other	44	47	3	7%
FY 2012 Total Scope 1	**41,039**	**44,328**	**3,289**	**8%**

So while the employee commute and business travel indicators are showing steady progress, at ORNL, T&D losses represent the largest category of Scope 3 GHG emissions. For the 2012 performance year, ORNL's T&D losses from purchased electricity grew by 31%. This is related to the consumption of purchased electricity to support ORNL operations and mission critical facilities. During the current performance period, electricity purchases grew from 362,025 MWh in the FY 2008 baseline year to 527,182 MWh, an increase of 45%.

Figure 5 is a graphic depiction of ORNL's Scope 3 GHG emissions performance for FY 2012, compared to the emissions relative to FY 2008 baseline year as established by Executive Order (EO) 13514. Again, total estimated Scope 3GHG emissions for FY 2012 equals 44,328 $MTCO_2e$ and represents an overall growth of 8%, attributed to the increase in T&D emissions.

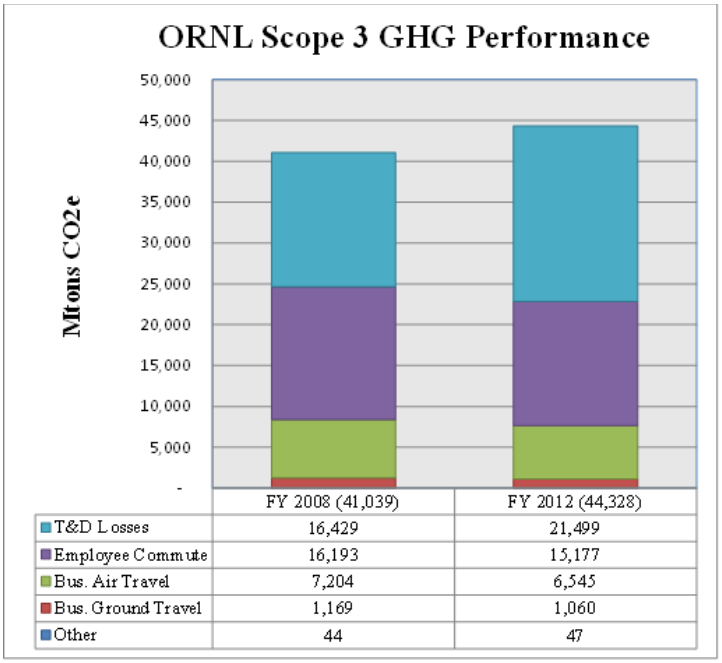


Figure 5. ORNL Scope 3 GHG emissions for FY 2012 compared to the FY 2008 baseline.

Highlights o*f *employee commute performance results

As recommended in the 2010 implementation report, a Transportation Council was established as a mechanism to institutionalize employee commute options and services. Quarterly meetings were held with influential decision makers from Human Resources, Facilities and Operations, Information Technology, and Transportation Research.

ORNL continued to promote carpooling and carpools (148 employees) that eliminated an estimated 757,748 miles of commute travel annually, eliminating 188,516 lb of CO_2. The use of alternate work hours (AWHs) by 237 employees eliminated 310,458 miles of commute travel. In partnership with *SmartTrips*, a program of the Knoxville Regional Planning Organization for commuting, *SmartTrips* and SCI promotional efforts resulted in a 45% increase in carpool match participation. Over 100 employees logged their green commute trips using the *SmartTrips* web site. Activities to engage employees were conducted, including a Green Commuter Pledge, where employee pledges to shift from driving alone to using some form of alternative mode; Earth Day; and on-site *SmartTrips* Seminars. Priority parking spaces for three-person and higher carpools have been successful, with permits issued for 8 four-person carpools and 18 three-person carpools. Opening the program to two-person carpools in 2013 would incentivize additional participation.

An additional commute option was added mid-way through 2012 with the development of official telework policies and a process for employee application and manager approval. SCI worked with the Human Resources Division to promote the new policy, developed on-line training materials for workers and managers, including a Telework web site, and held a seminar on "Making It Tele(Work) at ORNL" to roll out the new Alternate Work Location policy. As of the end of 2012, 50 Telework Agreements were being processed. Although policies, processes, and training tools are in place, the new program suffers from lack of acceptance among managers although many employees are genuinely interested in participating.

Plans, Actions, and Projected Performance

The three primary areas of plans, actions, and projected performance for Scope 3 activities are summarized here.

Transmission and distribution related efforts

Because the largest portion of Scope 3 GHG emissions is attributed to transmission and distribution (T&D) losses from purchased electricity, Scope 3 emissions (in total) are expected to increase as we approach the FY 2020 target year. The plan for mitigating the growth of T&D emissions is covered in the "Barriers" section below.

Transportation related efforts; plans and expectations for FY 2013 and beyond

- Continue to maximize transportation coordination and community outreach by coordinating with local, state, and federal telecommute and rideshare agencies. Further develop the regional transportation planning partnerships with *SmartTrips* and the Regional Planning Organization, and continue to participate in the *PlanET* Regional Consortium, sharing sustainability lessons learned with regional leadership.

- Conduct employee outreach and education to drive deployment of commute alternatives. Maintain/update the Telework web site, continue Green Commute Challenges and Earth Day promotions, update student orientation materials, hold a series of telework outreach sessions, promote rideshare matching, host multiple Smart Trips site promotions, and develop marketing materials to program development.
- Commute service and program development: Incentivize two-person carpool parking by designating priority parking spaces, provide staff support to the Transportation Council, and evaluate on-site services and initiate discussions of traffic improvements. Work with the Transportation Council to set telework agreement goals and to establish a method for data collection on telework and AWH participants.
- Evaluation research: Monitor the rideshare database and rideshare parking permit system; collect data from Human Resources on AWH participation (Figure 6); and conduct a teleworker and a telemanager survey to collect effectiveness, productivity, morale, and travel behavior data.

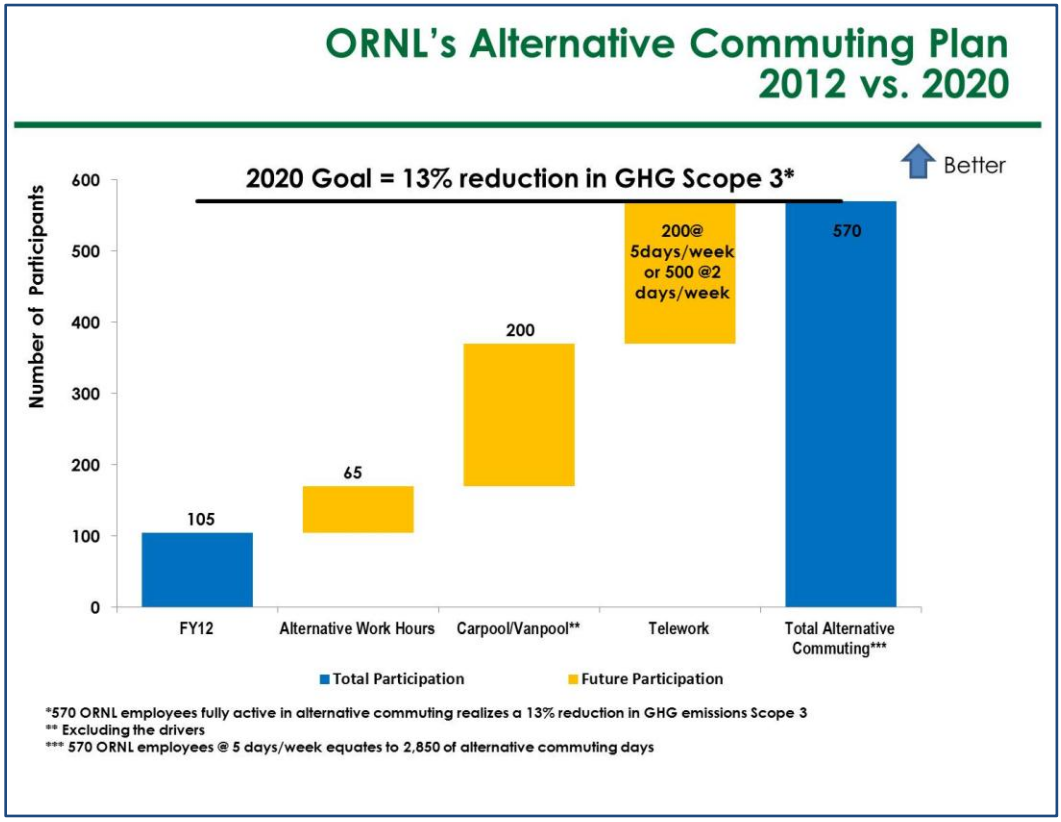


Figure 6. Alternative commuting waterfall chart with plans, actions, and projected performance.

Business air travel and business ground travel related efforts

Several federal, DOE, and ORNL travel initiatives emphasize the overall benefits of reduced business travel. Travel policies aimed at reducing cost also lead to the more efficient use of time and lessen GHG emissions by curtailing the use of travel-related fuels.

Recent initiatives have focused attention on the need to reduce travel-related expenditures and emissions. On November 9, 2011, the President signed EO 13589, *Promoting Efficient Spending*, requiring each agency to develop and implement policies and controls to ensure efficient spending on travel and conference-related activities. To further clarify the efficient spending actions required of government agencies, the Office of Management and Budget (OMB) issued Memorandum M-12-12, *Promoting Efficient Spending to Support Agency Operations*, on May 11, 2012. The memorandum specified that for FY 2013, each agency shall spend at least 30% less on travel expenses than in FY 2010. Agencies must also maintain this reduced level of spending each year through FY 2016.

General awareness of the cost, time, and environmental benefits of the better management of federal travel is expected to help obtain the GHG Scope 3 emissions reduction goal. Specifically for FY 2013, DOE has committed to the establishment of better defined M&O travel and conference guidance, which will help with Scope 3 GHG reduction targets.

Barriers

Due to the nature of Scope 3 emissions, and the acknowledgment that such emissions are beyond the direct control of organizations, reductions are dependent upon strong communications with our employees and regional partners. At ORNL, the Sustainable Campus Initiative is the primary management tool to ensure progress toward Scope 3 reductions related to employee commute, and business air and ground travel, using employee engagement in the attainment of the established goals. The rural setting of ORNL is a barrier to the development of public transportation options; therefore, removing barriers to employee engagement is one of the goals of the Sustainable Campus Initiative. Funding for this effort is an important indicator of management commitment to a sustainable future, and budget concerns could create an unwanted barrier if funding is reduced to the point of ineffectiveness.

The reduction of GHG emissions as a result of T&D losses is dependent upon our engagement with TVA to work in tandem to establish clean power production goals and to upgrade the T&D infrastructure. ORNL has a strong working relationship with TVA, and both DOE-OSO and ORNL have taken steps to strengthen those bonds in recent years. We have made progress in our aspiration to influence decisions that will result in improved operations. To reduce the T&D losses and to improve reliability, ORNL has engaged in successful negotiations with DOE and TVA to construct a new substation to service our significant computational loads. This substation will reduce the T&D losses for the medium voltage (13.8Kv) ORNL system. The substation project is currently in design and will be operational in early 2015. We have taken a proactive position and have included TVA as a key member of our solutions team for Scope 2 GHG reductions, which will also reduce T&D losses (Scope 3 GHG). ORNL will continue to work with TVA to influence improvements in T&D losses by reviewing the following options:

- By 2015 the 13.8 voltage substation will be moved closer to the computational load center to reduce T& D losses, reduce cost, and improve reliability
- Increase on-site generation of electricity by renewable sources
- Increase the purchase of green energy
- Work with TVA to influence the overall lowering of the carbon content in transmitted electricity

In summary, the risk of non-attainment of the Scope 3 GHG reduction goal of 13% is high, primarily due to T&D losses from electricity. The consumption of purchased electricity at ORNL is expected to grow by 174% from the baseline of FY 2008 to the goal year of FY 2020.

1.10 GHG – Scope 1 & 2

DOE Goal: 28% Scope 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline.

ORNL seeks to support DOE's Strategic Sustainability Performance Plan (SSPP) and GHG emission reduction targets developed in response to EO 13514 to the fullest extent possible. The overall goal of 28% has been established by the agency for the reduction of GHG Scope 1 and Scope 2 emissions (by FY 2020 from a FY 2008 baseline).

As part of the Sustainability Performance Office (SPO) guidance for the current SSP, GHG performance data from the FY 2008 baseline year was submitted back to ORNL via Tab 9.1 of the FY 2011 CEDR. After thorough analysis and review by DOE, the baseline as submitted by the site was returned with minor variations totaling less than 1% of the original site total estimate.

The various sections of this report (ORNL's SSP) will provide performance data from FY 2012 operations as well as details of our actions, past and present, which have led to the current state of environmental stewardship. Management, research scientists, and operations personnel have become more aware of how daily actions and behaviors can be modified to reduce carbon emissions, and this awareness is the foundation of site sustainability planning. The individual sections of this plan also discuss strategies and tactics that will lead to the reduction of carbon emissions. Strategies undertaken in response to previous orders and directives have positioned ORNL well as an operating facility with awareness of actions and resultant environmental impacts, including the emission of GHG. As a matter of chosen course, ORNL will continue the energy efficiency project plans and operational procedure improvements developed in response to previous directives and goals, including the ORNL Sustainable Campus Initiative. In addition, process improvement plans are being developed in a number of divisions, all working collectively to reduce GHG emission by source (covering all scopes) while improving operational efficiencies.

As is common throughout federal government operations, ORNL's greatest source of GHG emissions is a result of purchased electricity, the primary contributor of Scope 2 emissions. One of our most proactive planned actions (detailed in section 8.1 under Site Innovation) is to work with TVA, our regional electrical power provider, to influence the reduction of carbon content whenever possible. ORNL will aggressively strive to have a positive influence towards the overall DOE goal of a 28% reduction target for total Scope 1 and Scope 2 GHG emissions.

Performance Status

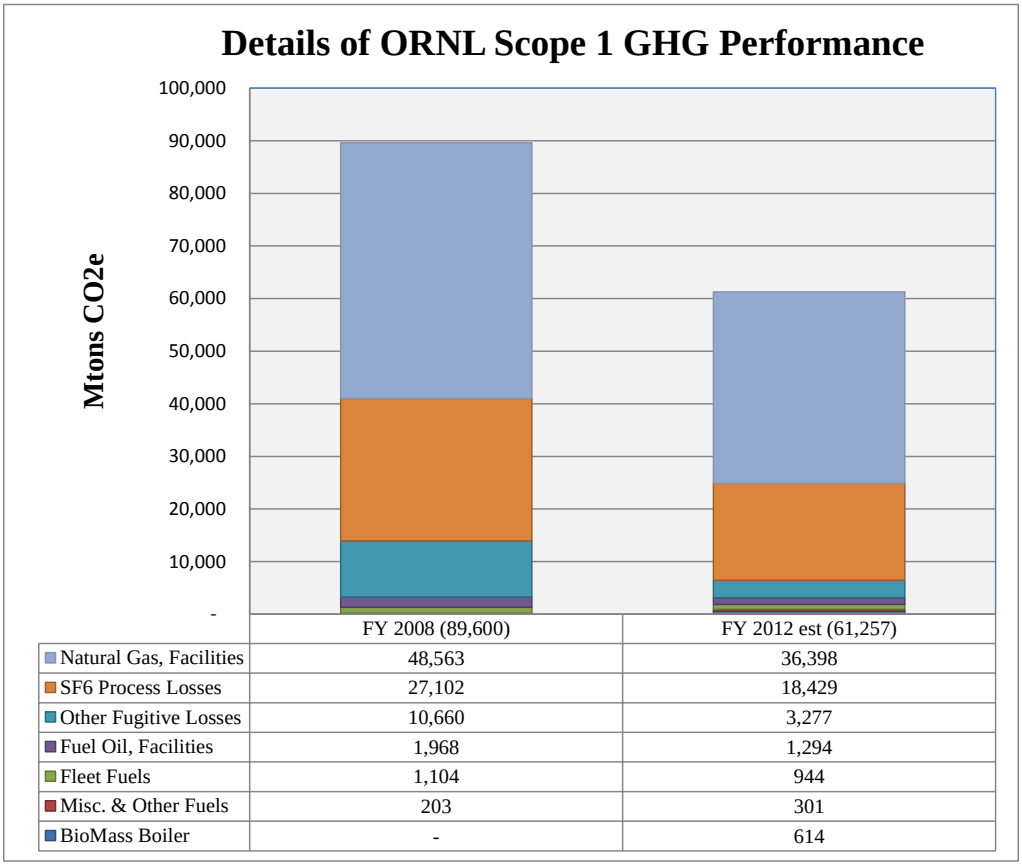
The ORNL FY 2012 GHG emission inventory was calculated using guidance from DOE in the form of a greatly enhanced CEDR calculation tool and reporting mechanism. The FY 2012 GHG emissions inventory as shown is consistent with the current guidance, using the calculation tools provided to all DOE sites for the completion of their SSP reports. All GHG performance data is reported in metric tons, carbon dioxide equivalency ($MTCO_2e$).

- The FY 2012 Scope 1 GHG estimate is 61,257 $MTCO_2e$, a decrease of 32% from the FY 2008 baseline. Scope 1 reductions are on target due to previously implemented ECM efforts and the results from the Johnson Controls ESPC implementation. The Biomass Steam Plant was a major ECM for this ESPC project and reached operational status in July 2012. This new system is the primary reason for the reduction in the amount of natural gas consumed at the site in FY 2012 and will drive further reductions in the future.
- The FY 2012 Scope 2 estimate is calculated at a net of 295,077 $MTCO_2e$, an increase of 18% from FY 2008. The increase in Scope 2 emissions is the result of growth in purchased power from TVA. As shown in Table 5, GHG emissions from operations totaled 326,388 $MTCO_2e$. Purchased RECs from wind power projects resulted in the avoidance of 31,311 $MTCO_2e$ in GHG emissions.
- The combined FY 2012 total Scope 1 and 2 estimate totals 356,334 $MTCO_2e$, an overall increase of 5% from FY 2008.
- Natural gas purchases for facility operations decreased by 25% in FY 2012 related to a FY 2008 baseline. Due to the mid-year commissioning of the Biomass Steam Plant, only an incremental amount of natural gas purchases was curtailed. As the unit reaches full operating capacity, natural gas needs will further decrease for FY 2013 and beyond.
- SF_6 process losses stabilized in FY 2012 and are expected to decline as plans for the decommissioning of the Holifield Radioactive Ion Beam Facility (HRIBF) continue to develop.
- Purchased electricity continues to grow as important mission facilities, such as world-class research in computational programs, continue to expand.

Table 5. Scope 1 and Scope 2 GHG performance data (FY 2012 to the FY 2008 baseline)

Scope 1 GHG Emissions ($MtCO_2e$)	**FY 2008**	**FY 2012**	**Increase (Decrease)**	**(% +/-)**
Natural Gas, Facilities	48,563	36,398	(12,165)	-25%
SF_6 Process Losses	27,102	18,429	(8,673)	-32%
Other Fugitive Losses	10,660	3,277	(7,383)	-69%
Fuel Oil, Facilities	1,968	1,294	(674)	-34%
Fleet Fuels	1,104	944	(160)	-14%
Other Facility Fuels	203	301	98	48%
BioMass Boiler	-	614	614	n.a.
FY 2012 Total Scope 1 Performance	**89,600**	**61,257**	**(28,343)**	**-32%**
Scope 2 GHG Emissions	**FY 2008**	**FY 2012**	**Increase (Decrease)**	**(% +/-)**
Purchased Electricity	249,407	326,388	76,981	31%
Purchased RECs – GHG Avoided	-	(31,311)	(31,311)	n.a.
Net Annual GHG Emissions	**249,407**	**295,077**	**45,670**	**18%**
Scope 1 & 2 GHG Emissions	**FY 2008**	**FY 2012**	**Increase (Decrease)**	**(% +/-)**
All Sources, Combined Calculation	**339,007**	**356,334**	**17,327**	**5%**

Table 5 lists each major component of Scope 1 and Scope 2 GHG emissions and shows the FY 2012 performance result of each category in terms of increase/decrease in metric tons of CO_2e from the FY 2008 baseline as well as the percentage gain/loss of each category. The lower part of the table shows the combined Scope 1 plus Scope 2 performance, an overall increase of 5% from FY 2008. Figure 7 and Figure 8 show the graphic representation of the Scope 1 details and the FY 2012 performance status of both Scope 1 and Scope 2 combined.



	FY 2008 (89,600)	FY 2012 est (61,257)
Natural Gas, Facilities	48,563	36,398
SF6 Process Losses	27,102	18,429
Other Fugitive Losses	10,660	3,277
Fuel Oil, Facilities	1,968	1,294
Fleet Fuels	1,104	944
Misc. & Other Fuels	203	301
BioMass Boiler	-	614

Figure 7. Details of ORNL Scope 1 GHG performance status for FY 2012.

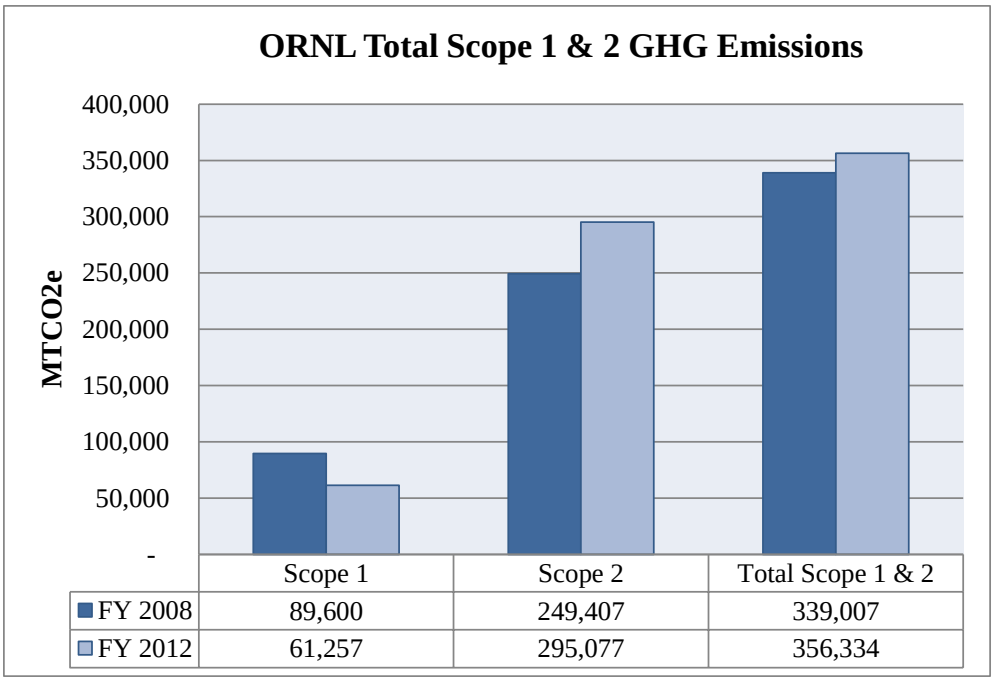


Figure 8. ORNL total Scope 1 & 2 GHG emissions performance status for FY 2012.

SF_6 is a key contributor to ORNL's Scope 1 GHG emissions inventory. It will be mandatory to actively manage SF_6 emissions in order to meet DOE's overall reduction goal of 28% for Scope 1. An overall awareness of the global warming potential (GWP) of SF_6 has resulted in a more cautious approach in the requisition and purchase of this potent GHG. ORNL is committed to evaluating potential process and purchasing improvements that will result in substantial SF_6 emissions reductions.

The HRIBF, located in Building 6000, was operated as a nuclear physics facility for research with radioactive ion beams from 1996 to 2012, and it maintains the largest inventory of SF_6 gas at ORNL. SF_6 insulating gas is required for safe operation of the HRIBF tandem accelerator to prevent electrical discharge from the high-voltage terminal and accelerating column to the pressure vessel. Normal process losses vary from year to year because the number of SF_6 transfer cycles from the tandem to storage and back varies from year to year. Losses during a typical transfer cycle are significantly larger than losses during a comparable period while SF_6 is resident in the tandem. For FY 2012, normal process losses were 1,700 lb, lower than the facility baseline of 2,500 lb/year as established as part of the ORNL FY 2008 GHG baseline analysis. See section 1.3 for more information on the SF_6 performance status.

Plans, Actions, and Projected Performance

Scope 1 reductions are on target for out-year reductions that will exceed the FY 2020 target reduction goal of 28% owing to the several factors summarized below.

ORNL key projections factors for FY 2020 GHG emission calculations:

- Natural gas purchases for facilities will decrease with the continued operations of the Biomass Steam Plant.
- Wood burned in the Biomass Steam Plant is less carbon intense than petroleum-based fuels.

- Fuel oil purchases will decline as more efficient systems are commissioned.
- SF_6 process losses are expected to remain at levels that are less than the annual average as established in the FY 2008 baseline as current operational plans maintained.
- Non-process fugitive emissions should continue to decline as research scientists are made aware of less potent alternatives for tracer gases and laboratory research.
- Purchased electricity will grow as critical mission facilities expand to meet national research demands.
- The SMR development will be a significant factor in the reduction of Scope 2 GHG emissions.

The greatest factor for future reductions can be attributed to the anthropogenic GHG emissions for the new Biomass Steam Plant that were calculated with the *FEMP Energy and GHG Reporting Tool*, also called the *Federal GHG Workbook*. In FY 2012 we realized less than 6 months of GHG reductions and energy savings. The first full year of production and savings will be FY 2013. The plant is expected to consume just over 3,000 tons of wood per month (37,150 tons/year). GHG projections to the FY 2020 target year currently estimate that GHG emissions from natural gas use will decline by over 70% and that during the same period, fuel oil for facilities will decrease over 60% compared to the baseline year of FY 2008.

ORNL Biomass Steam Plant project facts for sustainable operations and GHG reduction from FY 2013 to FY 2020:

- The previous natural gas boilers have been upgraded and now use biomass fuel as the primary energy source for FY 2013 and beyond.
- Annual cost savings are projected at $3.8 million per year.
- The base load of the biomass boiler is 60,000 lb/hour.
- Local biomass sourcing is a sustainable enhancement for the regional economy.
- Multiple opportunities for research include fuel analysis, synthetic gas, process metering and monitoring, and residual fuel analysis.
- The facility is a showcase for visitors and researchers.
- FY 2013 will be the first full year of operations and combined savings.

Table 6 shows the various categories of Scope 1 emissions by source, with FY 2008 and to FY 2012 actual data, as well as projections for out-years to the FY 2020 target year. During this period, Scope 1 GHG emissions are projected to decrease by 67% overall.

Table 7 contains current projections that Scope 2 GHG emissions will increase to an estimated 111% for FY 2020 from the FY 2008 baseline (gross annual emissions; assumes we do not use REC purchases as a GHG avoidance strategy). Detailed projections covering the future use of electrical energy resources can be found (as requested by the SSP guidance) in *Section IV: HEMSF: Projected Electrical Use & High Energy Mission Specific Facilities (HEMSF).*

Table 6. ORNL Scope 1 GHG emission projections

	ORNL Scope 1 GHG Projections FY 2008 to FY 2020, MTCO2e											Projection at FY 2020	
	FY 2008	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	Increase/ Decrease	%
BioMass Boiler	-	-	614	1,783	1,783	1,783	1,783	1,783	1,783	1,783	1,783	n.a.	n.a.
Natural Gas, Facilities	48,563	44,166	36,398	14,443	14,154	13,871	13,594	13,322	13,055	12,794	12,538	(36,025)	-74%
Fuel Oil, Facilities	1,968	5,780	1,294	813	801	789	777	766	755	744	733	(1,235)	-63%
Other Facility Fuels	202	313	301	289	277	266	256	245	236	226	217	15	7%
Fleet Fuels	1,105	944	944	925	907	888	871	853	836	820	803	(302)	-27%
SF6 Process Losses	27,102	112,745	18,429	17,345	16,261	15,177	14,093	13,009	11,925	10,841	10,841	(16,261)	-60%
Misc. Fugitive Losses	10,660	3,349	3,277	3,211	3,147	3,084	3,023	2,962	2,903	2,845	2,788	(7,872)	-74%
All Scope 1 GHG Emissions	**89,600**	**167,297**	**61,257**	**38,810**	**37,331**	**35,860**	**34,396**	**32,941**	**31,493**	**30,053**	**29,704**	**(59,897)**	**-67%**

Table 7. ORNL Scope 2 GHG emission projections with REC purchases

Purchased Electricity GHG Emission Projections (MTCO2e)	Scope 2 GHG Projections to FY 2020 (111% Growth)											Projection at FY 2020	
	FY 2008	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	Increase/ Decrease	%
	249,407	**367,671**	**326,388**	**419,770**	**417,890**	**450,980**	**516,117**	**520,705**	**546,239**	**536,062**	**526,025**	**276,618**	**111%**

Barriers

While Scope 1 emissions are on target for GHG reductions, Scope 2 reductions represent a tremendous challenge due to continued growth in electricity demands for mission-critical facilities such as the Spallation Neutron Source (SNS) and the multiple Computational Sciences facilities. ORNL's description of the conceptual plan to assist in the development of an SMR project is included as the first project in section 8.1 (Site Innovation and Government-Wide Support) of this report.

As part of the total GHG emissions, Scope 3 T&D losses from purchased electricity will also increase as we approach the FY 2020 target year. Though electricity usage increases by 174% during the goal period, Scope 2 GHG emissions will grow by only 111% due to expected overall emissions reductions by our power supplier. TVA has committed to a number of initiatives that serve to reduce carbon emissions and moderate the need for coal consumption during times of peak power demand. As a federal agency, TVA is also expected to play a role in federal leadership in EO 13514 goals. Recent annual reports show that decreases in carbon emissions are being realized while TVA has stated that their goal is to approach a 50% $MTCO_2e$ factor by 2015 (in FY 2008 the US Environmental Protection Agency [EPA] e-grid rate for the TVA region was 69%), so there is ample room for improvement. As the TVA GHG output emissions improve, ORNL's will follow.

ORNL's updated waterfall chart (Figure 9) is used to demonstrate the need for innovative and transformational technologies (such as the SMR as described in section 8.1) to help DOE realize the 28% reduction target/goal for Scope 2 GHG emissions. The chart also demonstrates the welcomed fact that FY 2012 performance, while still over the target, has decreased significantly over the same period in FY 2011, a testament to the fact that sustainability goals have moved to the front line of ORNL business and management practices.

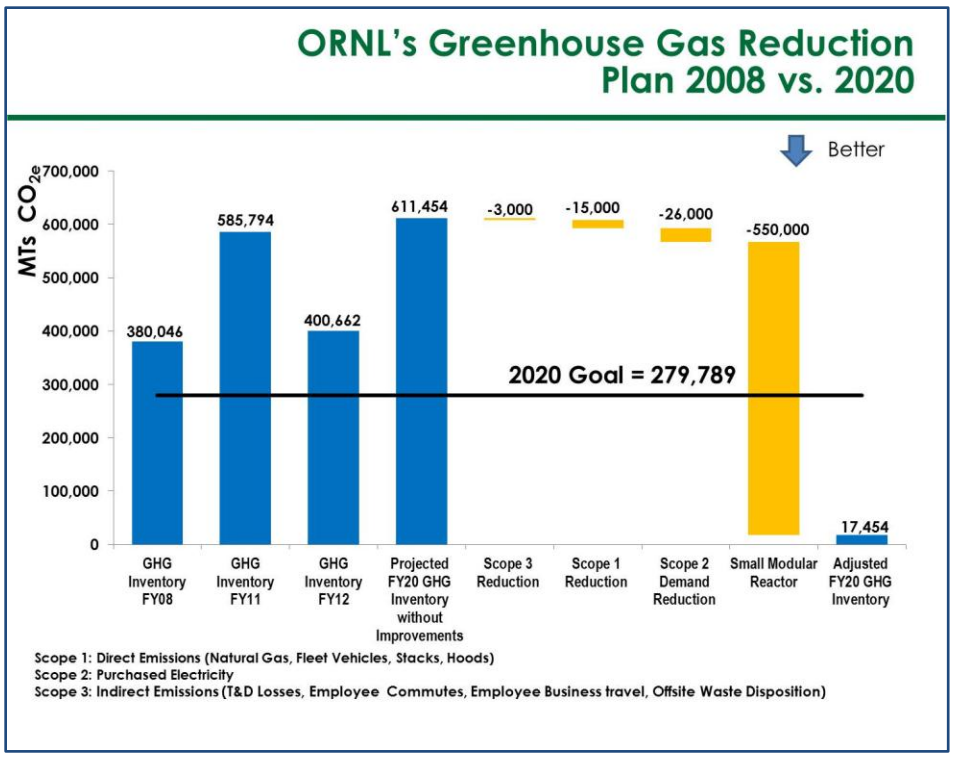


Figure 9. Greenhouse gas reduction plan yearly projections and potential project reduction sources (2020 goal = 279,789 MTCO$_2$e).

Goal 2: Buildings, HPSB, ESPC Initiative, and Regional & Local Planning

2.1.a Existing Buildings - High-Performance Sustainable Buildings Guiding Principles

DOE Goal: 15% of existing buildings (greater than 5,000 GSF) to comply with the five guiding principles of HPSB by FY 2015, with progress to 100% thereafter.

Existing facilities are being renovated to meet the guiding principles (GPs) for HPSBs. FIMS data is used as a base list to track existing HPSBs based on size and facility utilization. A prioritization tool was created to prioritize future prospects based on available metering data. A separate guiding document is used to centralize site-wide policies and procedures, as well as to track progress for each building's specific items such as commissioning and metering data.

Energy audits are performed for at least 25% of the site's covered facilities each year to identify potential ECMs, and buildings targeted as HPSB prospects are audited at least one year prior to the associated retrofits. This aids in the identification of ECMs and helps better position the facility to achieve HPSB status. The ECMs are evaluated for feasibility and return on investment. The approved ECMs are then funded and implemented in the audited facilities during the HPSB process.

Performance Status

In FY 2012, four facilities were evaluated and brought into compliance with the GPs for Federal Leadership in HPSB at ORNL. Buildings 1061, 1520, 4007, and 6008 all achieved this status. Buildings 1061 and 4007 are of identical construction type to HPSBs certified in FY 2011, so this allowed for a template approach that made the process effective and efficient. Building 1520, a facility that is primarily lab space, presented the first opportunity for use of the LABS 21 benchmarking tool in the process of demonstrating compliance. Policies and procedures have been maintained consistently across the HPSB portfolio and are aligned with site-wide standards to streamline the GP implementation.

Plans, Actions, and Projected Performance

Facility managers have assumed responsibility for fully supporting the establishment of HPSBs. Initial training has been provided and is ongoing for facility management staff. The facility managers serve an integral role in targeting buildings to ensure that we meet or exceed the target of 22 buildings (18 existing, plus four new constructions) by FY 2015, as illustrated in Figure 10. Seventeen buildings achieved HPSB status from FY 2010 to FY 2012, and plans are progressing to add another 12 existing buildings to the HPSB list by the target year of 2015.

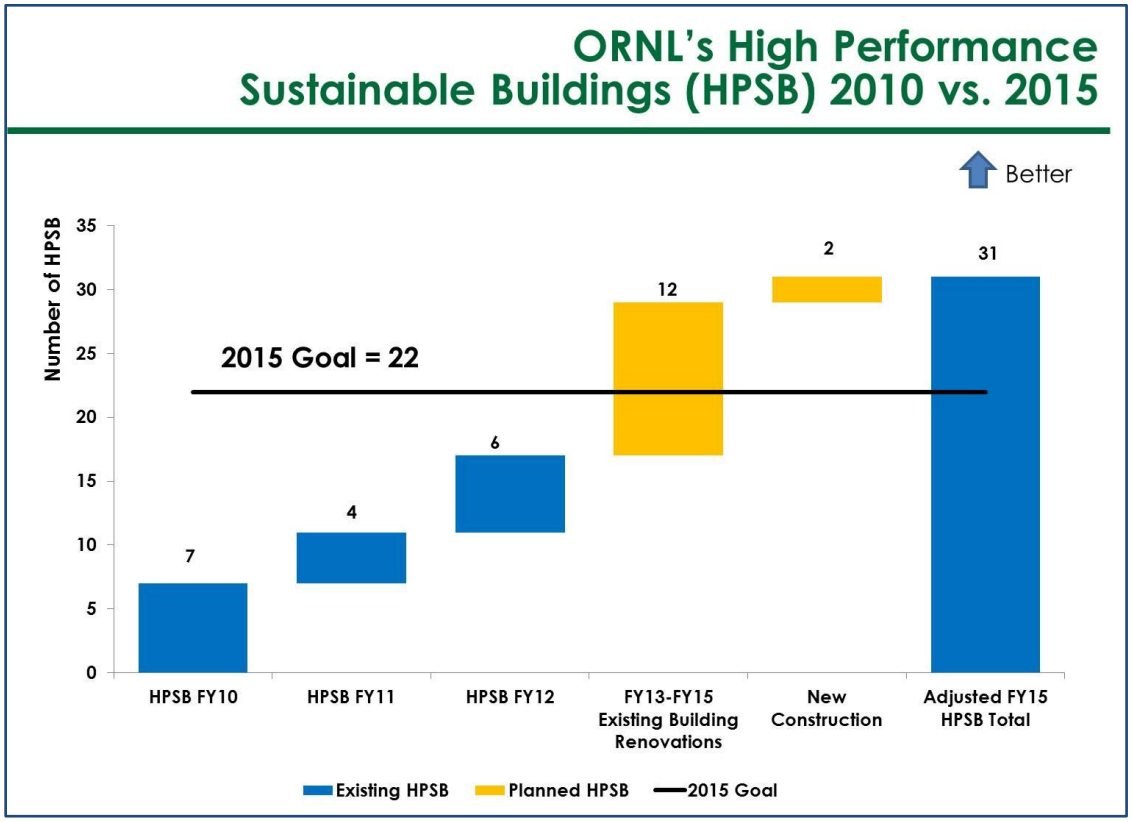


Figure 10. ORNL plan for high performance sustainable buildings (2020 goal = 22 HPSBs).

Barriers

The operating budgets in FY 2013 and beyond may limit special funding for implementation of necessary facility modifications, which could impact the goal.

2.1.b New Construction – Comply with High-Performance Guiding Principles

DOE Goal: 15% of existing buildings (greater than 5,000 GSF) to comply with the five guiding principles of HPSB by FY 2015, with progress to 100% thereafter.

Note: DOE proposed additional HPSB equivalencies in the 2012 SSPP guidance to consider buildings meeting the following criteria as complying with GPs: any building that achieves LEED-EB Silver or higher, or LEED-NC Gold or higher; Green Globes-NC rating of four, or a Green Globes CIEB rating of three; and any building occupied for more than one year that achieves Living Status designation by the Living Building Challenge.

Performance Status

As of the end of FY 2012, 15 facilities have been constructed to LEED standards. LEED certification has either been received or is in progress for the following facilities.

1. Bldg 1521 – ORNL West End Research Support Facility (LEED Certified)
2. Bldg 3625 (expansion) – Advanced Materials Characterization Laboratory (LEED Silver)
3. Bldg 4020 – MAXLAB Building Research Laboratory (LEED Gold pending)
4. Bldg 4100 – Chemical and Materials Science Laboratory (LEED Gold)
5. Bldg 5100 – Joint Institute for Computational Sciences (JICS) (LEED Silver)
6. Bldg 5200 – ORNL Conference Center (LEED Certified)
7. Bldg 5300 – Multi-Program Research Facility (LEED Gold)
8. Bldg 5600 – Computational Sciences Building (LEED Certified)
9. Bldg 5600 (expansion) – Multi-program Office Complex (LEED Gold, pending)
10. Bldg 5700 – Research Office Building (LEED Certified)
11. Bldg 5800 - Engineering Technology Facility (LEED Certified)
12. Bldg 7990 – Melton Valley Warehouse (LEED Certified)
13. Bldg 7995 – Melton Valley Maintenance Facility (LEED Gold)
14. Bldg 8630 – Joint Institute for Neutron Sciences (LEED Certified)
15. Bldg 8640 – ORNL Guest House (LEED Gold)

Plans, Actions, and Projected Performance

It is anticipated that the following new facilities will be constructed before FY 2015 and will achieve LEED Gold status:

- Bldg 8930 – Chestnut Ridge Maintenance Facility (in construction)

Barriers

Cost constraints in FY 2013 and beyond may limit funding for the implementation of necessary facility design and construction requirements, which could impact meeting the goal.

2.2 ESPC Initiative (i.e., Third Party)

ORNL continues to have planned discussions with Site Office. These include accomplishment of ECMs from CEDR and possible onsite generation projects. Although informal discussions have been held with ESCOs, no notice of opportunity has been submitted.

2.3 Regional and Local Planning

DOE Goal: ORNL continues to be actively engaged in regional and local planning for transportation options as well as outreach activities for the enhancement of sustainability effort in the entire southeast region.

Performance Status – FY 2012 Efforts and Year-End Summary

Transportation-related efforts

Developed regional partnerships with *SmartTrips* and Knoxville Area Transit (KAT)

- Met with representatives of the KAT to discuss the feasibility for the operations of a hybrid electric shuttle bus from downtown Knoxville and the Farragut Park and Ride lot into ORNL.
- Partnered with *SmartTrips* for commute promotional materials, transportation fairs, and other technical assistance, such as Emergency Ride Home and carpool matching services. Promotion of Smart Trips during its spring and summer "Commuter Challenge" resulted in an increase of 13% in ORNL employee participation. Currently 102 employees log their green commute trips using the *SmartTrips* web site. They include carpoolers, bicyclists, van poolers, and teleworkers.
- *SmartTrips* awarded ORNL its "Green Spirit" achievement award at the conclusion of the Commuter Challenge. ORNL jumped from fourth to second place in the number of green commuters among the region's largest employers. These include organizations such as TVA, City of Knoxville, Y-12, The University of Tennessee, and Denso. As part of the Commuter Challenge, several ORNL employees won prizes ranging from Amazon Kindles to $1,500 travel vouchers as a result of their participation in *SmartTrips*. These awards have been promoted in *ORNL Today* and continue to create interest in the program.

Other regional transportation partnerships were strengthened as well:

- Participated in the Knoxville Regional Transit Development Plan as a means of incorporating ORNL commute/transit needs, particularly in the Pellissippi Parkway Corridor, into the long-range transportation strategy for the region.
- Participated in the five-county East Tennessee Sustainability Initiative to provide input on land use, transportation, and planning.
- Initiated discussions with the East Tennessee Human Resource Agency (ETHRA) for access to vans for vanpool purposes.
- *Plan East Tennessee (PlanET)* is a regional consortium of communities whose goals are to leverage ideas and resources to create long-term change in the areas of jobs, housing, transportation, clean environment, and community health. The $4.5 million project is funded by the Department of Housing and Urban Development and the Department of Transportation to develop sustainability. ORNL was a founding member of the consortium and actively participates in regional forums, as well as serving on the Transportation and Infrastructure Working Group.
- SCI supported the Knoxville Regional Transportation Planning Organization (TPO) in the development of a Regional Transit Corridor Analysis, serving on the Regional Transit Corridor Study Committee to select the consultants and study future corridors for high performance regional transit.

- The Knoxville Regional Intelligent Transportation System (ITS) Architecture was updated in 2012 under the direction of the Knoxville Regional Transportation Planning Organization (TPO), in coordination with the Tennessee Department of Transportation (TDOT). ORNL served on the Knoxville Regional ITS Architecture Stakeholder Committee. The purpose of the committee was to work with the TPO and their consultant to develop an updated Regional Architecture and subsequent Deployment Plan. Technology is a means to reduce congestion and mitigate air pollution. ORNL participated in four stakeholder workshops that were held to ensure that the plan reflected the unique needs of the region. The Regional ITS Architecture provides a framework for implementing ITS projects, encourages interoperability and resource sharing among agencies, identifies applicable standards to apply to projects, and allows for long-range planning. The draft Final Deployment Plan has been issued for review and comment.
- The SCI worked with the City of Oak Ridge and TDOT to request that TDOT install a traffic signal at the west (SR95) portal to improve safety and circulation. TDOT approved a Spot Safety Improvement Project, and signalization will occur in the spring of 2013. The installation of the signal will increase safety and also reduce vehicle idling and emissions.

Other local and regional sustainability planning activities

Southeast Regional Summit

- In the spring of 2012, ORNL led the second on-site regional Sustainability Summit with approximately 125 from around the Southeast in attendance.
    - The goals of the Summit were to 1) share knowledge, 2) share best practices in terms of implementation strategies, and 3) further develop a Southeast regional sustainability process.
    - Key subjects of the summit were 1) transportation, 2) power generation, and 3) energy efficiency. The first two goals were met during the summit itself, and the third was met in a stakeholder meeting held immediately following the summit.

Regional Sustainability Process

- From the above-mentioned Summit, a leadership team was developed to begin addressing the Southeast region. Making up this team are representatives of St. Lucie County, Florida; Indian River State College (IRSC), Florida; TVA; Emory University; Clark Atlanta University; the State of Tennessee; ORNL; and the Oak Ridge Energy Corridor.
- This team met in May 2012 at ORNL, reviewing possible approaches to the Southeast, defining the scope of work, and assigning tasks for moving ahead. Key areas being discussed are energy efficiency; power generation; transportation; and social issues such as regional engagement, education, and wellness.
- As a result of the Summit and the regional process, IRSC and ORNL have signed a Work-for-Others agreement. Under this agreement ORNL has been consulting with IRSC toward the development of a Sustainable Campus Initiative at IRSC, patterned after the one at ORNL. The two main components of this joint effort are 1) development of an "umbrella" approach to sustainability and 2) examination of potential improvements to the power grid at IRSC and identifying related energy efficiency/cost improvements. In FY 2013, the scope is being expanded to including building technologies.
- In February, ORNL conducted a two-day workshop at IRSC to address the power grid at IRSC. A report was submitted to IRSC in March.

Plans, Actions, and Projected Performance

- Further develop the regional transportation planning partnerships with *SmartTrips* and Knoxville Area Transit (KAT).
- Continue to participate in the Knoxville Regional Transit Development Plan to promote ORNL commute/transit needs into the long-range transportation strategy for the region.
- Continue to maximize transportation coordination and community outreach by coordinate with local, state and federal telecommute and rideshare agencies.
- Further develop the regional transportation planning partnerships with *SmartTrips* and the Regional Planning Organization; and continue to participate in the *PlanET* regional consortium, sharing sustainability lessons learned with regional leadership.
- The Southeast Regional Summit is expected to become an annual event; the third ORNL Regional Sustainability Summit is being planned.
- The next step in the Indian River State College Agreement is for ORNL to lead a two-day workshop at IRSC on the subject of building technologies. This is currently being scheduled. Overall, this is a good joint opportunity for ORNL to assist in regional sustainability planning and for the work to be shared with others as the process moves forward.
- Key activities in the Regional Sustainability Process to be pursued from the second meeting include reviewing with the stakeholder group the next steps that the group can take to advance sustainability in the Southeast, including setting up a non-profit corporation.

Goal 3: Fleet Management

3.1 Fleet Alternative Fuel Consumption

DOE Goal: 10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline.

Fleet vehicle data is available in the Federal Automotive Statistical Tool (FAST) System.

Performance Status

Fuel data for FY 2012 reflects that ORNL has met the required annual 10% alternative fuel consumption increase. Of fuel consumed, 38% was alternative fuel in 2005, while 75.5% alternative fuel was consumed in FY 2012. This is an alternative fuel increase of 50% since 2005.

Because of the DOE-HQ mandate of 15% fleet reduction in CY 2011, ORNL reduced 58 vehicles, of which 60% were flex fuel vehicles and 9% were gasoline-hybrid passenger-carrying vehicles. The remaining 31% were gasoline and diesel vehicles.

An Idle Reduction Guide was created through the Sustainable Campus initiative to promote a culture of reducing unnecessary idling for all non-emergency vehicles operating both on- and off-campus. This Guide illustrates the many benefits for idle reduction, such as saving fuel and money, protecting public health and environment, and changing driver behavior.

ORNL has one E-85 pump and one B-20 pump located on site in the same fueling island. The vehicles that can use E-85 or B-20 are well marked both inside and outside the vehicle. Since ORNL is a closed campus with central fueling capabilities, not much off-site fueling occurs, which limits the concerns about the availability of alternative fuel stations. On-site outreach and education events have focused on alternative fuel vehicles and why they are used throughout the federal government and not just at ORNL.

Through a continued partnership with East Tennessee Clean Fuels (DOE Clean Cities), ORNL had a presence at all of the Knoxville Area Earth Day events as well as other education and outreach events focusing on alternative fuels and advanced vehicle technologies. ORNL continues to be a leader in alternative fuel use in the region, and ORNL's presence at the events with example vehicles and experts helps to bring awareness to the availability, benefits, and challenges associated with using more sustainable modes of transport. ORNL campus outreach events included the kickoff to the ORNL Earth Day seminar series, in which an Eco-Driving panel was organized that included speakers from fueleconomy.gov and a presentation on the benefits of idle reduction. A vehicle display focusing on electric and plug-in electric vehicles was also organized for the ORNL Earth Day event.

The issue of blender pumps and credits for low-level ethanol blends has still not been resolved. The growing popularity of blender pumps in the Midwest United States does provide some momentum for moving forward with this in the future. The EPA partial waiver for E15 (15% ethanol/85% gasoline) for newer vehicles also brings the issue into the spotlight. Though no changes have yet been made in the federal reporting guidelines, the issue is important to further reducing petroleum use and increasing alternative fuel use not only at ORNL, but within the whole of the federal fleet.

Fleet Management participated in a benchmarking exercise at the Idaho National Laboratory (INL). The benchmarking activity provided ORNL an opportunity to obtain a 36-passenger, diesel-hybrid bus from INL generating a cost savings of over $120 thousand.

Plans, Actions, and Projected Performance

ORNL's planned fleet measures include continuing to replace older vehicles with alternative fuel vehicles (AFVs) as funding will allow and procuring electric low-speed vehicles (LSVs).

To ensure there are zero missed opportunities for fueling AFVs with alternative fuels, Fleet Management will continue to assess the AFV fuel usage on a monthly basis.

Fleet management is also investigating the opportunity of establishing a motor pool at a certain location where the staff can reserve and check out a vehicle using a key valet automated process.

Barriers

Budget reductions will impact the purchase of electric and hybrid replacement vehicles. To purchase passenger-carrying vehicles of the aforementioned fuel type, approval must be granted to ORNL by Congressional appropriation to DOE-HQ. After two years of not receiving such authorization, ORNL received appropriation to purchase three passenger-carrying vehicles in FY 2012. The inconsistency of being granted appropriations impedes the vehicle planning process of purchasing alternative fuel vehicles.

One of the concerns in the vehicle reduction initiative is the expectation that employees will utilize their personal vehicles in the performance of their employment. No guidance has been provided to the field to verify that this is an option when vehicles are not available in the performance of staff duties.

3.2 Reductions in Fleet Petroleum Consumption

DOE Goal: 2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline.

Fleet vehicle data is available in the FAST System.

Performance Status

Goal 3.2 requires that ORNL should achieve at least 14% reduction in fleet petroleum consumption relative to the FY 2005 baseline. In FY 2012, ORNL has met a 21% reduction. To ensure that this effort of reduction continues, ORNL is continuing to increase the use of alternative fuels, increase the fuel economy of the fleet vehicles, and reduce the number of vehicle miles driven. In FY 2012, vehicle miles were reduced by 15% from FY 2011 mileage. In addition, the DOE-OSO local utilization mileage goal was met with 100% utilization.

Of additional note, ORNL has strategically placed 125 bicycles throughout the Campus for staff use in an attempt to further reduce petroleum fuel consumption. Twenty-six percent of the LSVs utilized on campus are electric vehicles.

Plans, Actions, and Projected Performance

As funding is provided and the appropriate approvals are granted, ORNL will continue to replace inefficient vehicles with AFVs and hybrids, replace heavy-duty vehicles with units that have a smaller gross vehicle weight rating, and procure electric LSVs to replace gasoline-powered LSVs.

ORNL's planned fleet measures include

- Zero waivers for using petroleum fuel in AFVs
- Zero missed opportunities for fueling AFVs with alternative fuels
- Continuing to replace older vehicles with AFVs and hybrids as funding allows
- Implementing initiatives that will decrease idling practices by personnel
- Obtaining hybrid vehicles to provide the on-site taxi/shuttle activity with better-fuel-economy vehicles
- Reducing vehicle miles traveled through teleconferencing, trip consolidation, use of mass transportation, etc.

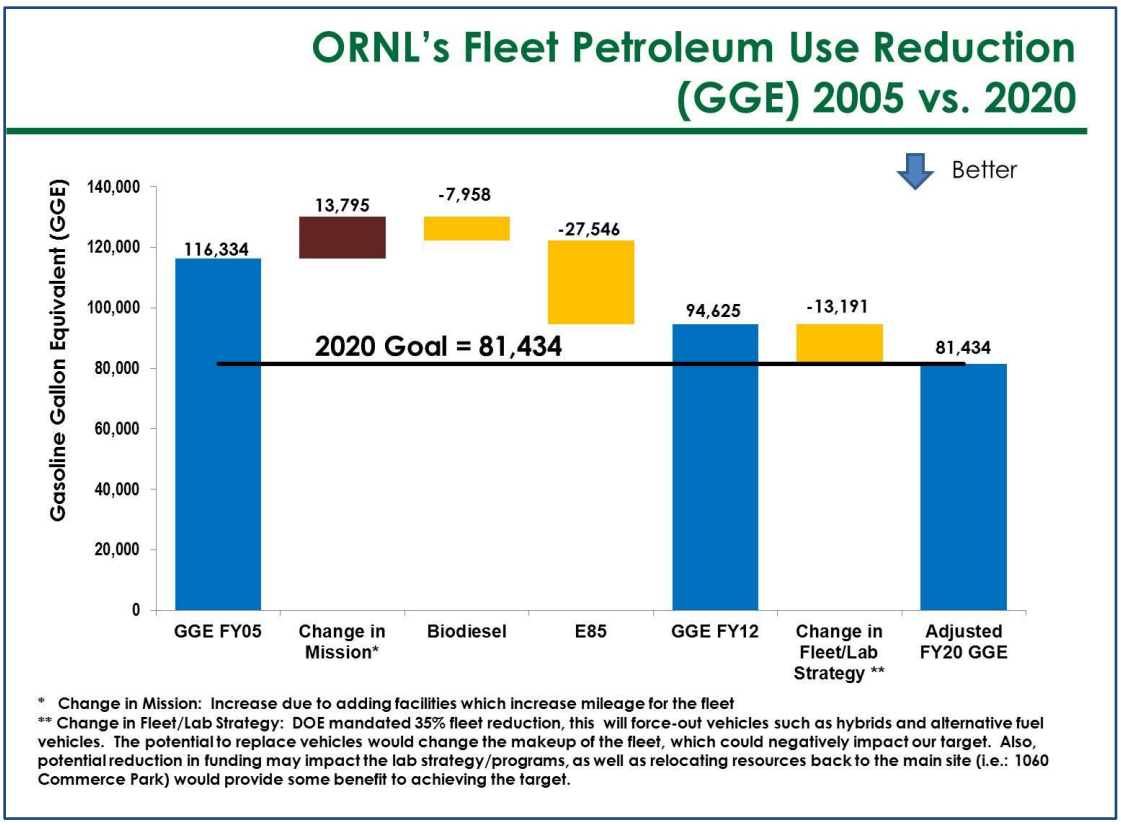


Figure 11. Waterfall Chart Reflecting ORNL's Fleet Petroleum Use Reduction.

Barriers

The risk assumption associated with this goal is the availability of alternative fuels. ORNL currently has four types of fuel available on site: unleaded gasoline, E85, biodiesel, and diesel. If E85 or biodiesel becomes unavailable, or if any technical problems with these fuels or fueling infrastructure arise, gasoline and diesel fuel will have to be used.

3.3 Purchase of AFVs for Light-Duty Vehicle

DOE Goal: 100% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2015 and thereafter (75% FY 2000–2015).

Fleet vehicle data is available in the FAST System.

Performance Status

ORNL continues to support the 75% AFV acquisition requirement by purchasing available flex-fuel vehicles from the General Services Administration (GSA). These purchases will continue to depend upon available funding and approval. There were only two light-duty vehicles purchases in FY 2012, and both vehicles were AFVs, which allowed this goal to be met at 100%.

Plans, Actions, and Projected Performance

ORNL will continue to replace vehicles that meet the 41 CFR 102-34.270 criteria with AFVs as funding and appropriations allow.

Barriers

Costs are significantly higher for hybrid and/or electric vehicles than for E-85 or B20 compatible vehicles. For example, for an electric cargo van with a gross vehicle weight rating (GVWR) of 10,001–19,500 lb, the fuel cost is $170 thousand, whereas a B20 compatible cargo van of 16,001 GVWR has a fuel cost of $52 thousand. Both vehicles reflect GSA pricing with the same options. Until initial costs of electric vehicles are comparable to other vehicles, selecting electric vehicles to purchase will continue to be a struggle. In addition, electric vehicles on the GSA vehicle ordering system are limited compared to flex-fuel and B20 compatible vehicles.

3.4 Right-Size Your Fleet Plan

Submit Right-Sizing the Fleet Management Plan for approval by December 31, 2012. Identify mission critical/non-mission critical vehicles by December 31, 2012.

ORNL is developing a Plan for Right-Sizing the Fleet and will submit it to the Office of Science no later than December 31, 2012. The Plan will also provide any vehicle reduction ORNL accomplished between January 1, 2012, and December 31, 2012 (i.e., number of vehicles in the ORNL fleet as of December 31, 2012).

Performance Status

In FY 2012, ORNL reduced 58 vehicles, of which 69% were AFVs (60% flex-fuel and 9% gasoline/hybrids).

Plans, Actions, and Projected Performance

ORNL will complete a Plan for Right-Sizing the Fleet as defined in Goal 3.4. This Plan will evaluate what ORNL fleet vehicles meet the definition of "mission-critical vehicle," and it will be submitted to the Office of Science as directed in the October 23, 2012, electronic message.

Barriers

Barriers and/or risks associated with this Goal can be defined as follows:

- Liabilities associated with employees who are driving personal vehicles in performance of their job duties.
- Elimination of mission-critical vehicles in order to meet a reduction percentage.
- Campus-bound vehicles, that is, LSVs (golf carts, ATV, Club Cars), which cannot travel to other ORNL sites because of the main highways that interconnect with the Campus.
- Removal of agency-owned vehicles that do not have a monthly fee as per GSA leased vehicle rules.

Goal 4: Water Use Efficiency and Management

4.1 Potable Water Use Intensity

DOE Goal: 26% potable water intensity (G/GSF) reduction by FY 2020 from a FY 2007 baseline.

All water used at ORNL is procured from the city of Oak Ridge as potable water. Throughout this report water use intensity is defined as gallons per gross square foot (G/GSF).

ORNL management long ago recognized the need to become better stewards of water. The highest water-use year at ORNL was FY 1985, when 1787 million gallons per year (MGY) was used. Significant decreases in water use were realized over the next four years with a water consumption of 1149 MGY in FY 1989, a reduction of over 35%. Water use stayed relatively the same through FY 2002 with fluctuations of around 200 MGY depending on operations at the HFIR and other large experimental facilities like ORELA and the Holifield Radioactive Ion Beam Facility.

New facilities that utilized closed-loop cooling technologies began coming on line in FY 2002 to replace older facilities that utilized once-through cooling (OTC) practices. At the same time, HFIR was undergoing upgrades and the number of operating cycles was reduced. Since HFIR uses 1.1 million gallons a day when it operates, water use at ORNL was impacted below what would be considered normal use. These factors combined to further reduce water use at ORNL to the lowest level in over 30 years at 852 MGY in FY 2006, a reduction of over 52% from FY 1985. Since FY 2006 significant computer center facilities have been brought on line, HFIR has been operating consistently, and the SNS Project was completed and has been steadily increasing power and cooling needs. The result of these additions has been an increase in water use.

In FY 2007, the baseline year for water reduction, ORNL used 877 MGY, almost 51% less than in FY 1985. The addition of water-intense activities such as computer centers, HFIR, and SNS resulted in increases in water use each year since FY 2007 to 1023 MGY in FY 2010, still almost 43% less than in FY 1985. At the same time several water-efficient facilities were built and several old facilities demolished, which resulted in the water intensity increasing from 176 G/GSF in FY 2007 to 202 G/GSF in FY 2010.

Since FY 2008 several significant water-saving activities have been initiated that are now coming to fruition. An energy savings performance contract (ESPC) was awarded that included energy conservation measures (ECMs) for water, resulting in saving almost 170 MGY. The ORNL Utilities Division has worked with two different leak detection companies to identify and repair leaks in the water distribution. An effort by the Facilities Management Division to identify and repair leaks in buildings has resulted in significant water savings. In addition, the R&D organizations have been replacing once-through cooling (OTC) equipment with stand-alone coolers or have installed flow reducers where OTC could not be eliminated. This has also resulted in significant water saving. The cumulative result of these efforts was a water use of 635 MGY in FY 2012, over 64% less than in FY 1985, and a water intensity of 113.5 G/GSF in FY 2012, a reduction of 35.5% since FY 2007, which exceeds our FY 2020 goal of a 26% reduction.

Performance Status

ORNL has put in place an aggressive plan to reduce water consumption. During FY 2012 the following water saving initiatives were completed:

- Repaired leaks and replaced several old lines in the site water utility distribution system
- Repaired leaks in several facilities
- Eliminated OTC

Two leak detection companies, New York Leak Detection and American Leak Detection, have been employed by the Utilities Division to help identify leaks in the water distribution system. Both companies have been effective in identifying and quantifying leaks across the site. In addition, the Utilities Division has a plan to replace sections of piping that have been assessed as needing replacement. In the process of replacing lines, leaks have been discovered and repaired.

The Facilities Management Division has an active program to identify leaks within buildings and make repairs. A Fix-A-Leak initiative was started to bring awareness to the entire staff at ORNL to instruct them to contact the facilities organization to implement repairs. The Fix-A-Leak initiative went one step further to encourage staff to be aware of their home surroundings and make repairs at home too. The program has been affective in bringing a significant awareness to ORNL staff. Facilities management staff have also assessed buildings and repaired leaks that would not be evident to the general staff.

Over 10 years ago the ORNL Director issued a memo to staff to minimize the use of OTC. Several initiatives have been implemented over the years since then that have reduced water usage. This desire to reduce the use of OTC has been one of the objectives in the design of new facilities built since that time. The most recent building project, Building 4100, removed operations from Buildings 3137, 3150, 4508, 4500N, and 4500S. Most of these operations were traditionally heavy water users, and this move drastically reduced water use by employing closed-loop cooling. Another heavy user, the Physics Division in Building 6000, has implemented a project to drastically reduce their use of OTC by installing flow control valves and eliminating cooling water entirely when air-cooled fans could be employed.

To better understand water use at ORNL, a water-metering plan is being implemented. A prioritized list to install meters has been developed and will continue to be implemented as funds are identified. Meter locations at 33 facilities will account for over 90% of the water use at ORNL. To date 17 of these 33 facilities have been metered. In addition, a plan has been developed to install seven water meters at strategic locations within the water utilities distribution system. Fourteen meters were installed at building locations in FY 2012.

ORNL was approved to have a water audit done by the DOE-SPO in FY 2011. The team from Pacific Northwest National Laboratory conducted the audit the last week in September 2011. ORNL received the report from the audit in June 2012 and will incorporate the findings and suggestions in our planning basis.

Plans, Actions, and Projected Performance

To fully understand how ORNL will address the water intensity reduction, modernization activities must be considered that include both elimination and addition of facilities. A facility disposition plan has been developed through FY 2020 and is summarized in Table 8. Facilities totaling 222,216 SF that use

984,375 gallons of water per year (GPY) are planned for demolition by the end of FY 2020. This activity is funded by the Environmental Management Program Office.

Table 8. ORNL facility disposition plan

Estimated Disposition Year	Number of Facilities	Gross SF	Water Savings (gallons)
2013	5	7,925	90,000
2014	11	101,684	545,625
2015	6	12,772	0
2016	0	0	0
2017	10	0	0
2018	5	18,775	0
2019	41	74,489	348,750
2020	8	6,571	0
Total	98	222,216	984,375

A strategic plan, summarized in Table 9, has been developed through FY 2020 to add new facilities to meet mission goals.

Table 9. Planned facilities with their associated area, estimated water use, and funding source

FY	Property Name	Gross SF	Water Use (GPY)	Funding Source
2013	Carbon Fiber Technology Facility	50,000	250,000	MIE GPE
2013	Max Energy Efficiency Building Research Lab	20,000	641,250	LI Program
2013	MRF Switchgear Building	2,100	0	IGPP
2014	Chestnut Ridge Maintenance Shop	20,000	816,000	IGPP
2014	7000 Area Storage Building	10,000	0	IGPP
2016	RATS II Warehouse Addition	7,000	36,000	IGPP
2017	Chestnut Ridge Office Building	18,000	72,000	LI LL
2017	Site Operations Center	50,700	300,000	LI LL
2020	Radiological Labs and REDC Office Building	20,000	80,000	LI Program
	Totals	197,800	2,195,250	

As shown in Table 10, a total of 197,800 SF of facilities that will use an estimated 2,195,250 GPY are planned for completion by the end of FY 2020.

Table 10. Planned facilities by year of completion, adding gross SF and water use

Estimated Year Added	Number of Facilities	Gross SF	Water Use (gallons)
2013	3	72,100	891,250
2014	2	30,000	816,000
2015	0	0	0
2016	1	7,000	36,000
2017	2	68,700	372,000
2018	0	0	0
2019	0	0	0
2020	1	20,000	80,000
Total	9	197,800	2,195,250

Table 11 shows the summary of several water saving initiatives that are underway or planned through FY 2020.

Table 11. Water savings initiatives by year and by associated funding source

FY	Activity	Gross SF	Water Saved (gallons)	Funding Source
2013	Water management improvements	0	5,000,000	Operating
2013	Installation of water saving devices	0	15,000,000	Operating
2014	4500S/4508 Water Elimination	0	100,000,000	IGPP
2015	Increase Condensate Return Percentage	0	10,000,000	IGPP
2017	Replace TSF Water Supply	0	2,000,000	IGPP
2019	7900 Area Water Distribution System Upgrades	0	1,000,000	IGPP
2019	Potable Water System Upgrade Phase I	0	30,000,000	IGPP
2020	Potable Water System Upgrade Phase II	0	30,000,000	IGPP
2020	Potable Water System Upgrade Phase III	0	30,000,000	IGPP
	Additional Possible Totals		223,000,000	

Based on the data provided above, Table 12 shows the anticipated water intensity at ORNL through FY 2020.

Table 12. Actual and projected water use intensity estimates by year

FY	Projected Area (SF)	Projected Use (gallons)	Projected Water Intensity (G/GSF)	Water Intensity Goal (G/GSF)
2007	4,975,592	876,814,000	176	176
2008	4,880,778	880,056,000	180	173
2009	5,021,366	996,171,000	198	169
2010	5,062,030	1,023,052,000	202	166
2011	5,420,439	890,477,000	164	162
2012	5,595,453	635,236,000	114	159
2013	5,659,628	616,037,250	(109)	155
2014	5,587,944	516,307,625	(92)	152
2015	5,575,172	506,307,625	(91)	148
2016	5,582,172	506,343,625	(91)	145
2017	5,650,872	504,715,625	(89)	141
2018	5,632,097	504,715,625	(90)	137
2019	5,557,608	473,366,875	(85)	134
2020	5,571,037	413,446,875	(74)	130

Barriers

No barriers to meeting the DOE goal have been identified. The current performance of 114 G/GSF exceeds the FY 2020 water intensity goal of 130 G/GSF as established as the baseline.

EISA Section 438 – Storm Water Management

EISA Section 438 stipulates that, "The sponsor of any development or redevelopment project involving a federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow." EO 13514 required EPA to create guidance to implement this section, which can be found on EPA's website. The definition of development and redevelopment, for the purposes of Section 438, is found in the EPA guidance and excerpted below.

> "*Development or re-development*. For the purposes of this provision this term applies to any action that results in the alteration of the landscape during construction of buildings or other infrastructure such as parking lots, roads, etc., (e.g., grading, removal of vegetation, soil compaction, etc.) such that the changes affect runoff volumes, rates, temperature, and duration of flow. Examples of projects that would fall under "re-development" include structures or other infrastructure that are being reconstructed or replaced and the landscape is altered. Typical patching or resurfacing of parking lots or other travel areas would not fall under this requirement."

As stated in the *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act*, the 95th percentile rainfall event is used to calculate design quantities at the ORNL site.

Strategic plans for ORNL that included demolition and renovation of old facilities and construction of new facilities have considered and incorporated green infrastructure and low-impact development (GI/LID) practices to infiltrate, evapotranspire, and/or harvest and use stormwater onsite to the maximum extent as is technically feasible. GI/LID approaches and technologies have been utilized that mimic the natural hydrologic cycle processes of infiltration, evapotranspiration and use. GI/LID practices that have been incorporated at ORNL include:

- Trees and tree boxes
- Rain gardens
- Vegetated swales
- Pocket wetlands
- Infiltration planters
- Porous and permeable pavements
- Vegetated median strips
- Reforestation and revegetation
- Protection of riparian buffers and floodplains

As noted, there are plans to continue modernization activities at ORNL. These plans include GI/LID approaches and technologies to mimic the natural hydrologic cycle processes of infiltration, evapotranspiration and use.

EISA Section 432 – Water Evaluations

As stated in the Draft Guidance for the Implementation of EISA Section 432, "The EISA facility project management approach is a cyclical process of continuous improvement that is intended to "ensure persistence of savings of implemented projects" and provides a structure for ongoing evaluation of facilities, implementation of energy and water saving projects, and reporting of project and performance impacts. This four-year cycle of activity includes evaluating facilities, identifying and implementing projects, and following up on and maintaining efficiency measures as part of the re-evaluation process to ensure an ongoing cycle of continuous improvement."

In support of EISA Section 432 a full energy and water audit was conducted at ORNL in FY 2008. Covered facilities were identified and a schedule established to audit 25% of the facilities annually to ensure 100% of the covered facilities would be audited in four years. Starting in FY 2009 energy and water audits have been conducted annually for covered facilities with associated ECMs identified.

In FY 2008 DOE signed an ESPC with Johnson Controls, Inc. to perform a full energy and water audit at ORNL and execute ECMs determined to fit within the criteria established for ESPCs. Of the approved ECMs, three resulted in saving water: ECM 12.1 Biomass Steam Generation, ECM 13.1 Domestic Water Conservation, and ECM 13.2 Elimination of Once-Through Cooling.

ECM 12.1 Biomass Steam Plant production resulted in saving 11.8 MGY in FY 2012. This ECM was not intended to be a water-saving ECM, as the goal was to convert the old fossil-fueled facility into a biomass-fueled facility. Water savings was an additional positive result of this ECM.

ECM 13.1 Domestic Water Conservation was completed in March 2009 and resulted in saving 12.3 MGY. This ECM included the audit of 65 buildings at ORNL that were deemed to be the primary water use buildings. In all, 448 toilets were replaced with low-flow fixtures and flush valves, 158 urinals were replaced low-flow fixtures and flush valves, 526 lavatories and sinks were fitted with low-flow aerators, and 122 showers were fitted with low-flow shower heads.

The scope of ECM 13.2 Elimination of Once-Through Water was to replace the central compressed air plant with a more efficient facility that utilized an evaporative fluid cooler system, similar to a cooling tower except the cooling fluid is circulated in an inner closed bundle located in the tower. This ECM was completed in October 2009 and resulted in saving 145.6 MGY.

The energy and water audit that was conducted in FY 2009 included 18 buildings and included water-related ECMs that were identified and addressed. Subsequent energy and water audits have likewise identified water-related ECMs that have been addressed. The most recent energy and water audit for FY 2012 (still in draft) is the fourth in the series and was conducted on the last 22 buildings that had not been audited. This audit was conducted on Buildings 970, 1061, 1504, 1505, 2007, 2519, 2547, 2661, 3027, 3037, 3129, 3144, 3500, 3502, 4007, 4500N, 4509, 7002, 7005, 7006, 7007, and 7910.

4.2 ILA Water Consumption

DOE Goal: 20% consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY 2020 from a FY 2010.

Industrial, landscaping, and agricultural (ILA) water is considered to be nonpotable freshwater used for aiding processes such as cooling, washing, and manufacturing or for irrigation and other uses related to the production of agricultural products. Since all water at ORNL is potable water, all water used at ORNL will be included in the potable water category and no water will be included in the ILA category.

The EPA's Draft Guidance for EO 13514 water goals provides clarification of the proper categorization of various types of water usage. The guidance documents clarify that only nonpotable water should be included in the ILA goal and potable water used for ILA should be reported in the potable water goal to avoid double counting.

Performance Status

Not applicable

Plans, Actions, and Projected Performance

Not applicable

Goal 5: Pollution Prevention and Waste Reduction

ORNL's Pollution Prevention (P2) program embodies the commitment of ORNL management and staff to reduce waste generation and toxicity; to promote environmentally preferable purchasing and resource conservation to embrace sustainability, stewardship philosophies, and measures; and to fully comply with state, federal, and DOE requirements concerning pollution prevention.

The program and supporting Pollution Prevention Program Plan captures ongoing and planned activities and is wholly supportive of DOE's sustainability program initiatives. Accomplishment of the ORNL goals requires merging administrative and cultural changes with new technologies and procedures.

Waste management and toxics reduction

- The generation of waste and pollutants is minimized through source reduction.
  - ORNL has long focused on source reduction as the primary way of reducing waste generation including sanitary, hazardous, and radioactive waste.
- The philosophy is incorporated into our work controls for research and operational activities.
  - ALARA practices
  - Chemical hygiene
  - Work control procedures
  - National Environmental Policy Act (NEPA) project reviews
  - Each year, waste generating divisions select one or two projects to implement that will address ORNL's identified targets and objects under the Lab's Environmental Management System (EMS). The divisions select a waste reduction, energy efficiency, or procurement project to implement during the course of the year. The projects are shared with other appropriate divisions and, in many cases, other DOE sites and DOE-HQ as P2 success stories.
- ORNL has taken steps to reduce the amount of material going to the landfill.
  - Development of contract language requiring construction contractors to recycle as much construction debris as possible, and report the recycled amounts, has resulted in significant amounts of material diverted from the landfill.
  - For routinely generated waste, ORNL has analyzed the types of waste going to the landfill and determined that our routine waste is predominately office trash. After an analysis of dumpster contents, it was determined that as least 30% of the material in the trash could have been recycled in established programs. To make sure the maximum amount of waste was diverted to the recycling streams, each employee was issued a collection container for their office or work areas so segregation could take place in offices and break rooms. Additionally, large recycling bins are provided in areas where personnel moves are taking place, so that as employees thin out their files while packing, they can place the paper directly in the recycling bins, preventing it from inadvertently being placed in the trash.
  - Recycle/reuse is maximized for both municipal solid waste and construction and demolition waste, including traditional streams such as scrap metal and paper, and innovative streams including off-site recycling of broken furniture and public sale of polyurethane packing foam.

Based on these and many other efforts to divert municipal solid waste and construction and demolition waste, in FY 2012 ORNL realized a 33% diversion rate for municipal solid waste (an increase from 26% in FY 2011) and a 78.9% diversion rate for construction and demolition waste.

5.1 Solid Waste Reductions (nonhazardous, other than construction waste)

DOE Goal: Divert at least 50% of nonhazardous solid waste, excluding construction and demolition debris, by FY 2015.

Performance Status

As shown in Table 12, ORNL's diversion rate for municipal solid waste in FY 2012 was only 33%, as supported by data reported in DOE's Pollution Prevention Tracking and Reporting System (PPTRS). While this is lower than the FY 2015 50% goal, we have achieved an increase compared to 26% realized in FY 2011.

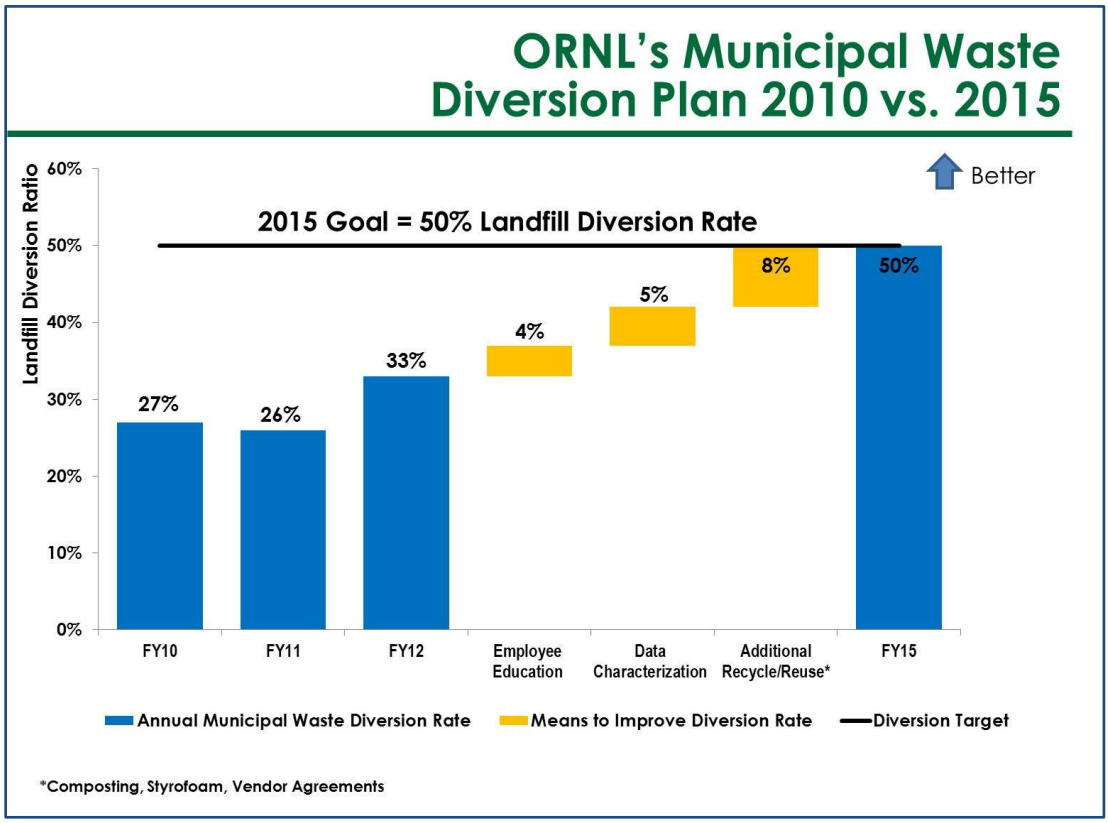


Figure 12. Waterfall chart showing the progression and gaps toward the municipal waste diversion goal of 50% by FY 2015.

Plans, Actions, and Projected Performance

To reduce the amount of material going to the landfill, ORNL will pursue:

- Continued monitoring of the material going into dumpsters to determine if there are additional materials that have the potential for source reduction, recycling, or sale.

- Enhanced communications with divisions and facility managers concerning which materials are acceptable in the recycling streams (e.g., fiberboard, colored paper).
- Evaluation of increasing diversion of compostable and organic material from the waste stream. ORNL conducted a thorough analysis of the organic waste generated by the Lab's cafeteria operations and determined that food preparation averages 46 kg/day and post-consumer waste averages 16 kg. This amount of waste is too small for ORNL to cost-effectively compost alone. ORNL has held exploratory meetings with other facilities concerning potentially combining the Lab's generation with other local institutions and partnering with a local business for the composting operation.
- Continued active identification and implementation of options to reuse or recycle the waste ash that is generated by the new Biomass Steam Plant.
- Evaluation and implementation of recycling of any new material streams identified, such as polystyrene packaging.

Barriers

Please see the "barriers" discussion at the end of this section for a combined discussion of all barriers and issues related to both municipal solid waste and construction and demolition waste.

5.2 Construction and Demolition Materials and Debris

DOE Goal: Divert at least 50% of construction and demolition materials and debris by FY 2015.

Performance Status

ORNL's diversion rate for construction and demolition debris has consistently exceeded the 50% goal.

- FY 2010 – 85.6%
- FY 2011 – 61.9%
- FY 2012 – 78.6%

Supporting data were reported in DOE's PPTRS. Certain wastes were disposed as construction and demolition debris rather than low-level radioactive waste due to efforts to extensively characterize wastes from demolition activities that would have otherwise been sent off-site for costly disposal as low-level radioactive waste. This effort allowed ORNL to determine that these wastes could be sent to the on-site landfills, which reduced waste management costs, but also prevented the Lab's diversion rate from being even higher this year.

Plans, Actions, and Projected Performance

ORNL continues to pursue efforts to divert construction and demolition (C&D) wastes:

- Effective contract language has been developed that requires construction contractors to recycle as much C&D debris as possible and report the recycled amounts. That language will continue to be included in contracted construction projects.
- Building on the successful C&D recycling for construction contracts, ORNL expanded a C&D collection program piloted in FY 2011 for internal remodeling debris from activities in existing

facilities. A vendor and storage location are used for recycling wallboard, rubble, wood, ceiling tiles, and metal. The collection of remodeling debris will continue and expand across the facility.

- There are internal NEPA reviews for most projects performed at ORNL. The P2 program has the opportunity to provide input. These reviews promote discussion with project engineers to plan for the reuse of soils, concrete, asphalt, and other C&D materials.

Barriers (for both Solid Waste Reductions and C&D Waste)

Additional P2 issues include the anticipated impact of population change, construction, decontamination and decommissioning activities, and Lab activities on recycling and waste generation rates and volumes. Barriers include:

- ORNL's Sustainability and P2 programs acknowledge that waste generation can be very dependent of numbers of personnel and funding levels. Waste generation can also fluctuate with changes in R&D mission. ORNL saw record amounts of waste generation in FY 2010 and FY 2011 associated with ARRA funding that supported the demolition of several buildings. The construction of ORNL's new MAXLAB prompted the move of Lab personnel who had occupied laboratories in other areas for ORNL for many years. As they left, they critically evaluated their chemical inventories, thereby generating a lot of one-time waste. ORNL also has experienced an increase in retirees due to incentive programs, resulting in the generation of one-time wastes from office cleanouts by the retirees. To address ever-changing needs, ORNL has focused on putting systems in place to address sustainability. The integration of sustainable operations is addressed in the Laboratory Agenda, budget planning guidance, internal procedures, and procurement evaluations. ORNL will continue to look for focused opportunities for waste streams reductions but will also concentrate on the more sustainable practice of source elimination.
- ORNL does not currently have a waste-to-energy system. Organizations that invest in these systems often improve their sustainable operations goals.
- With regard to printer and paper management, the Information Technologies Services Division (ITSD) completed a thorough evaluation of division printer costs and usage which included the numbers and models of printers, toner cartridges, and paper usage. They are piloting a networked printer, toner use, and paper management project for their organization. If it is cost-effective, ORNL will evaluate its applicability lab-wide. ORNL's usage of recycled content paper still has room for improvement. The P2 program will continue to work with buyers and procurement to improve this performance.
- ORNL is increasing the use of acceptable nontoxic or less-toxic alternative chemicals and processes while minimizing the acquisition of hazardous chemicals and materials. ORNL conducted an operational assessment of chemicals that reviewed the acquisition, distribution, storage, usage and reallocation and disposition. The new Chemical and Materials Science Building (4100) was designed to facilitate optimal chemical inventory management, chemical usage, and sharing. The Chemical Management Center promotes the transfer of excess materials to new users, and the procurement pathway is designed to promote internal acquisition/exchange before purchase.
- ORNL has implemented an integrated pest management program (IPM) that includes both interior and exterior strategies which focus on pest management inside and around buildings and facilities, facility grounds, and for the entire Oak Ridge Reservation. Practices include environmental controls such as ensuring all cracks and holes are sealed to minimize pathways for

pests to enter a building, and educating building occupants as to the importance of good housekeeping regarding food storage, waste collection, and plant maintenance. The goal is to reduce the exposure of building occupants and maintenance personnel to potentially hazardous chemical, biological, and particulate contaminants that adversely affect air quality, human health, building finishes, building systems, and the environment while controlling potential infestations of insect, rodents, fungus, and invasive plant species. More IPM program details are included in Section 8.1 *Site Innovation* of this SSP report.

- ORNL P2 staff participated in a team review of the Property Management procedures. ORNL has increased staff awareness of what materials can be sold, and expedited the process as needed to reduce the amounts of materials subject to both recycling and waste deposition.
- Finally, the ORNL P2 program continues to prioritize the minimization of the generation of waste and pollutants through source reduction. Avoiding waste generation will be given precedence over recycling or reuse even if it appears to be a detriment to recycling diversion goals. For example, last year ORNL eliminated the purchase of bottled water except for instances where staff members do not have access to plumbed water. This effort ultimately reduced the amount of recycled plastic water bottles. The avoidance of generating plastic bottles is the preferred outcome from both a waste and cost perspective.

Goal 6: Sustainable Acquisition

6.1 Sustainable Acquisitions and Procurements

DOE Goal: Procurements meet requirements by including necessary provisions and clauses (Sustainable Procurements / Biobased Procurements).

Performance Status

UT-Battelle continues to provide assistance to DOE though direct participation and support of DOE's efforts to meet energy efficiency goals and objectives. Specifically, UT-Battelle has made significant progress in its efforts to ensure that 95% of all new contracts, including nonexempt contract modifications, require products and services that are energy-efficient, water-efficient, bio-based, environmentally preferable, non-ozone depleting, contain recycled content, and are nontoxic or less-toxic alternatives.

Supporting tasks completed toward this goal:

- The standard contract terms and conditions, which are made part of all procurement actions for commercial items and services, invoke the following contractual requirements:
  - FAR 52.223-2 Affirmative Procurement of Bio-based Products Under Service and Construction Contracts (Dec 2007)
  - FAR 52.223-15 Energy Efficiency in Energy-Consuming Products (Dec 2007)
  - FAR 52.223-16 IEEE 1680 Standard for the Environmental Assessment of Personal Computer Products (Dec 2007)
  - FAR 52.223-17 Affirmative Procurement of EPA Designated Items in Service and Construction Contracts (May 2008)

- The clauses included in the UT-Battelle standard terms and conditions are an integral part of subcontract actions including purchase orders and all Accelerated Vendor Inventory Delivery (AVID) releases. The standard terms and conditions for construction and dismantling, demolition, and removal of improvements do not include FAR 52.223-16 (EPEAT) as that clause is not applicable to that type of service, but do include the other three clauses. The only subcontracts that do not incorporate the standard terms and conditions that contain the clauses above are real property lease agreements, government transfers, and memorandum purchase orders with other management and operating (M&O) contractors. Additionally, transactions made with a purchasing card (P-Card) do not include any terms and conditions.
- During FY 2012 a total of 20,467 subcontract, purchase order, and task order actions were issued. All of the new subcontract actions (100%) included terms and conditions with requirements related to DOE requirements for energy efficiency and sustainability.
- All UT-Battelle Blanket Ordering Agreements (AVID JIT Agreements) include UT-Battelle standard terms and conditions for commercial items. There were 59,730 AVID individual material releases processed in FY 2012.
- The commercial item terms and conditions under these AVID JIT Agreements not only contain the FAR provisions listed above but include additional requirements for promoting and providing environmentally preferable products. As a result, all AVID releases (100%) carry the same environmental preferable product requirements as a conventional purchase order or subcontract.
- The Contracts Division includes subcontract language with key commodity suppliers requiring they provide detailed reports on the supply of EPP, including reports on ENERGY STAR and EPEAT designated electronics.
- Procurements made using an authorized purchasing card (P-Card) do not carry any provisions related to sustainable acquisition. During FY 2012 there were 35,550 P-Card transactions.

Plans, Actions, and Projected Performance

With the inclusion of clauses and provisions that stipulate Environmentally Preferable Purchasing requirements in standard terms and conditions, UT-Battelle will continue to include these requirements in the majority of issued purchase orders, subcontracts, and task order actions. New awards of purchase orders, subcontracts, and task orders will automatically include the required provisions. All material releases against AVID Blanket Ordering Agreements will also continue to be governed by the provisions included in the standard terms and conditions.

UT-Battelle's Contracts Division has established an electronic file initiative, converting all active hardcopy subcontracts to an electronic database. All new subcontracts awarded after October 1, 2012, will be maintained electronically, which is three years ahead of the ORNL Sustainability target date and represents estimated cost savings in excess of $222,610 annually.

UT-Battelle is exploring and identifying opportunities for sharing of their existing electronic catalog(s) in an Electronic Catalog Sharing Initiative (eCSI) with National Renewable Energy Laboratory (NREL) under consideration as a possible participant. The eCSI concept creates a collaborative platform where UT-Battelle can leverage their purchasing capabilities and provide procurement services in a more effective and efficient environment.

Goal 7: Electronic Stewardship and Data Centers

Server virtualization technologies continue to grow at ORNL. Most of the enterprise servers are already operating in a virtual environment, and as systems are refreshed the replacements are virtualized where feasible. During FY 2012, 40 kiosks were converted to zero clients. A zero client is a more secure version of a thin client without an operating system and is more energy efficient than a computer in sleep mode. ORNL also performed an application virtualization pilot that proved the concept successful for virtualizing core ORNL applications. These core business and research applications are now internally and externally available for use from the virtual environment. A small set of employees have also been provided a way to store their data centrally instead of locally on their desktops via folder redirection, which allows seamless data aggregation and access from any device, including virtual desktops. Plans are to deploy this capability more broadly across the Lab during FY13.

Over the next year, ORNL IT will be moving its production data center and enterprise systems to a new data center, and will use this opportunity to further virtualize systems where feasible since many systems will be replaced as part of the data center relocation.. Also, as part of this data center move, ORNL has considered and will be utilizing GreenIT measures in the floor design and layout of system racks to reduce power consumption and minimize heat. Application virtualization and data centralization continues to empower the users to decrease dependencies on multiple devices for single computing tasks, and help the user centralize their applications and data on servers, instead of local devices. The terminal server cluster that provides application virtualization will continue to expand to include personal virtual desktops. These virtual desktops will enable users to log into any device from anywhere and view their desktop, settings, applications, and documents. A zero client pilot is also in progress. We expect to continue to replace kiosks and public-facing devices such as conference room computers during FY 2013.

7.1 Meters for the Measurement of Power Utilization Effectiveness (PUE)

DOE Goal: All data centers are metered to measure a monthly PUE (100% by FY 2015).

Performance Status

ORNL continues to look for ways to reduce energy use, maximize efficiency, and minimize the cost of operations in our data centers. As the data centers grow to remain at the leading edge of computing technologies, sustainability efforts have helped to dramatically reduce the energy footprint required to perform great science.

1. ORNL has introduced a standard for metered power strips that capture amperage, humidity, and temperature. For all new installs, the new metered power strips are part of the standard installation, while all current equipment is being retrofitted with the standard meters as budget allows. This is an educational effort as it gives the research community visibility into the energy consumption of their systems, and the data gathered is readily available.
2. ORNL continues to improve chiller operations and air management to reduce the amount of cooling required to keep the data centers at operable levels. A "quick start" feature was added to chiller control schemes to reduce chiller restart times, as well as reduce the amount of uninterrupted power supply (UPS) devices and generators, and the size of proposed chilled water storage tanks needed to provide uninterrupted chilled water for data center cooling. ORNL has

investigated a method for optimizing control schemes for chilled water systems and condenser water systems for optimal energy efficiency by matching cooling load and environmental conditions with available equipment. ORNL has also made piping provisions to isolate chilled water supplied to its data centers to allow chilled water to be supplied at a higher temperature. Variable frequency drives have been added to condenser water pumps and flow limiters were added to cooling towers to optimize flow to the cooling towers.

3. Data center computer room air management continues to improve. ORNL has instituted central humidity sensor locations for control of all humidifier equipped computer room air conditioner (CRAC) units. These sensors (humidification/reheat is turned off in the summer and dehumidification is turned off in the winter) have resulted in saved energy by eliminating the CRAC units from fighting each other to maintaining humidity set points. Top hats have been installed on CRAC units to allow return air to be pulled from just below the ceiling where air is warmer, reducing the mix of hot and cold air, and achieving full CRAC capacity that has resulted in the use of less energy to run fan and chilled water pumps in CRAC units. CRAC units have been equipped with supply air temperature controls that regulate chilled water to meet air temperature set points, reducing the amount of chilled water flow, pump energy, air flow, and fan energy required to operate the CRACs. CRAC sensors were calibrated and control access protection implemented with passwords so that random set point changes from untrained operators can be prevented. ORNL has installed dampers or lids on CRACs that are non-operational to prevent back flow of under-floor air.

   In the previous year, a pilot program of utilizing a heat containment system within the data center was completed with unsuccessful results. Subsequently, a cold aisle containment system was installed on the same set of cabinets within the data center. The implementation of this system resulted in a 100% reduction of temperature related alarms in the area, and stabilized the input temperature within the cold (supply side) aisle of the cabinets. Computational Fluid Dynamic analysis of cold aisle containment systems (in general) show that the reduced bypassing of air results in higher return temperatures to the air handlers, which then allows for higher capacity within each air hander. Eventually, as this system is deployed throughout the laboratory, it may result in the decommissioning of additional air handlers, thereby reducing the waste of energy from constantly turning fan motors.

   Also in the past year, empty space was converted to data center space as part of a long-term strategy to provide more hosting capabilities for non-supercomputing systems. Energy saving was an integral part of the design, which utilizes cold aisle containment for better separation of the hot and cold aisles, along with in-row cooling, to reduce the mechanical load by localizing the cooling efforts.

   Last, flow from variable air volume (VAV) boxes providing fresh air to data center rooms was adjusted for minimal room pressurization and night set back control was instituted.

4. ORNL has participated in the DOE EE HPC WG (Energy Efficiency for High Performance Computing Working Group) Standards Development for Chip Cooling, where the group's goal is to establish liquid temperature guidelines for HPC systems and facilities. Currently, the group has defined designs for wet bulb and dry bulb temperatures for 90% of DOE facilities, established basic cooling architectures for cooling towers and dry coolers for air and liquid cooling of the chip case, established the allowable chip case temperature, established typical approach

temperatures for various heat exchangers, and prepared a table defining basic infrastructure characteristics with the recommended and abnormal chilled water temperature supply temperatures.

5. ORNL data centers currently follow all ORNL Standards Based Management System (SBMS) requirements for disposal of computing equipment.
6. UT-Battelle has established standards for computers, monitors, and printers. All established electronic standards meet EPEAT bronze or higher requirements. The standard electronics are procured through pre-negotiated BOAs. The agreements contain specific clauses and provisions requiring that a) "…energy consuming products are energy efficient…" (FAR 52.223-15), and b) "…furnish…only personal computer products that (are)…EPEAT Bronze registered or higher." (FAR 52.223-16). The majority of purchased electronics are acquired through ORNL BOAs.

It should also be noted that all purchase orders issued for electronics that are not necessarily an established standard also carry the same energy efficiency provisions and requirements. Through UT-Battelle's standard terms and conditions, the delivery of energy efficient electronics is part of the contractual agreement of any supplier providing such products.

Finally, the BOAs for electronics contain additional requirements for reporting the number of units delivered meeting the EPEAT and ENERGY STAR requirements. These reports are submitted by the suppliers to UT-Battelle as requested. The reports submitted for FY 2012 electronic purchases indicate that 99.23% of all electronics delivered through the BOAs met or exceeded an EPEAT Silver or better rating. Of all electronics purchased (such as desktops, monitors, and laptops) through the BOAs, 97-100% were rated as EPEAT Gold.

Plans, Actions, and Projected Performance

1. Once all metered power strips are installed, ORNL should be able to determine kilowatt-hour usage based on consumption per power strip.
2. By improving the chiller plant and air flow in the data centers, ORNL anticipates further energy reduction and improved performance. Once funding has been secured for the optimized chilled water system controls, sustainability improvements will be achieved by reducing energy, water, water treatment chemical consumption, and reduced tower blow-down to area creeks. The chilled water supplied to the data center at a higher temperature will require air flow improvements to alleviate high-cabinet-temperature alarms and the addition of variable flow devices (VFDs) to certain chillers in the chiller plant.
3. CRAC and air flow improvements will continue to be made as budget allows, and all lessons learned will be incorporated into future projects. The largest barrier to adoption regarding air-flow improvements has been the funding model for data center operations. Any improvements that require either the use of labor or purchase of materiel are basically unfunded, as they apply to the data center as a whole system, rather than an individual user. For example, blanking panels are considered the easiest mechanism to improve air flow within a data center, but for cabinets that are sitting empty, there are no tenants to charge for the cost of blanking panels. The barrier is not limited to this example, but it is the easiest to illustrate. The overall complex facility funding model covers the facilities managed by the Facilities Management Division (FMD), and there is a

funding gap between what FMD covers and the customer covers, but that Lab Space Management has responsibility over.

4. UT-Battelle will continue to work with ORNL personnel and key suppliers to ensure that the desktop and laptop computers acquired by the Lab meet or exceed the EPEAT and ENERGY STAR minimum ratings whenever possible. In FY 2013, UT-Battelle will use a series of communication strategies designed to remind employees of its responsibility to specify and use energy-efficient products. In addition, UT-Battelle will closely monitor acquisition activities throughout the fiscal year as it relates to electronic products.

Barriers

Barriers are identified as specific to the individual technical approach and are discussed as presented in each subsection above. In addition, another barrier is obtaining non-project funds for the installation of additional chilled water metering required for a more accurate PUE calculation.

7.2 Annual Weighted Power Utilization Effectiveness Goals

DOE Goal: Maximum annual weighted average PUE of 1.4 by FY 2015.

Performance Status

ORNL has been metering power usage at most of its facilities over the past few years. During July 2009 the calculated PUE for both data centers averaged 1.336. Since that time, cooling, electrical distribution, and power metering improvements have been implemented. In reference to Tab 5.1 (Data Center Information) from the submitted ORNL CEDR spreadsheet, the calculated PUE value at year end FY 2012 is 1.29 for the Building 5300 data center and 1.26 for Building 5600. The data center metering program is still in transition due to the change from *PowerNet* to ION and the continued need for funding BTU meters to monitor chilled water. With improvements in the data center metering program, our ability to provide monthly and annual PUE calculations will continue to progress toward the FY 2015 goals.

Chilled water is supplied for HVAC and data centers from several chiller plants. Accurate PUE calculation, therefore, requires metering of water flow and temperature at several different locations to determine cooling. Installation of several BTU meters has been completed. However, a few more BTU meters are needed to completely measure the source of all data center cooling.

As power meters exist in each chiller plant, power per ton-hour or chiller plant efficiency is known. This can be factored into PUE calculations after installation and measurement of the last BTU meters and ton-hours from each plant contributing to data center cooling.

Plans, Actions, and Projected Performance

Plans for FY 2012 have been made to install the last BTU meters needed to accurately apportion chilled water to data centers. Longer-term solutions include the following considerations in reference to servers and equipment. The selection of equipment used within a data center is crucial to the level of energy consumption at a location. The changes that can be made to reduce energy consumption range from purchasing the most efficient and modern equipment to simply configuring existing equipment differently within the data center. Thus, a comprehensive knowledge of best practices encompassing policies and

technologies is the best weapon against data center energy use. ORNL proposed to study and implement "best practices" as they relate to servers and associated equipment. The majority of the existing IT equipment in the data center with the worst PUE is scheduled to be consolidated into a new data center that has implemented the industry best practices to date. This effort will improve ORNL's average PUE. Previous recorded PUE data suggests ORNL is already ahead of the PUE goal for 2015, but ORNL has internal goals to continuously improve PUE. Currently ORNL is striving to obtain PUEs for its HPC systems in the lower end of the 0.1-0.2 range.

Potential savings identified by project are listed in Table 13.

Table 13. Potential savings identified by project

Project Description	Savings
Reduced quantity and size of equipment for reduced storage tank capacity	$64,500
Optimized chilled water system control	3,816,000 kWh and 2,223,000 gallons of water
Higher chilled water temperature	14,700,000 kWh
Data center air management	60,000 kWh per year

Storage Devices

- Storage redundancy needs to be rationalized and right-sized to avoid rapid scale-up in size and power consumption.
- Consolidating storage drives into a Network Attached Storage or Storage Area Network are two options that take the data that does not need to be readily accessed and transport it offline.
  - Lowers the storage and CPU requirements on the servers
  - Directly corresponds to lower cooling and power needs in the data center
  - For data that cannot be taken offline, it is recommended to upgrade from traditional storage methods to thin provisioning
  - Consideration of cloud storage and maximization
- Dependent upon funding:
  - ORNL plans to use computer systems that have even lower unit energy consumption and that are designed to operate at higher chilled water temperatures and higher air temperatures
  - Long-term plans to continually optimize system performance

Barriers

Primary barrier to improving ORNL's PUE is getting funding for lake water cooling. This will be critical for the future HPC systems which will be brought online in the coming years.

7.3 Electronic Stewardship

DOE Goal: 100% of eligible equipment with power management actively implemented and in use by FY 2012.

Performance Status

ORNL has successfully met the electronic stewardship goal of power managing 100% of the eligible personal computers, laptop computers, and monitors. The progression of electronic stewardship and electricity savings is shown in Figure 12 (above). Power management capabilities are required during requisition and purchase for standard computer hardware, and on-site equipment is power controlled by using Verdiem Surveyor during times of employee inactivity for all compatible hardware. Mac desktops were not eligible for power management in FY 2011, but an upgrade to the Verdiem software to version 6.0 has provided the technical capabilities for power management enforcement on the Mac platform. The software upgrade is currently being tested and will be in a production mode in FY 2013.

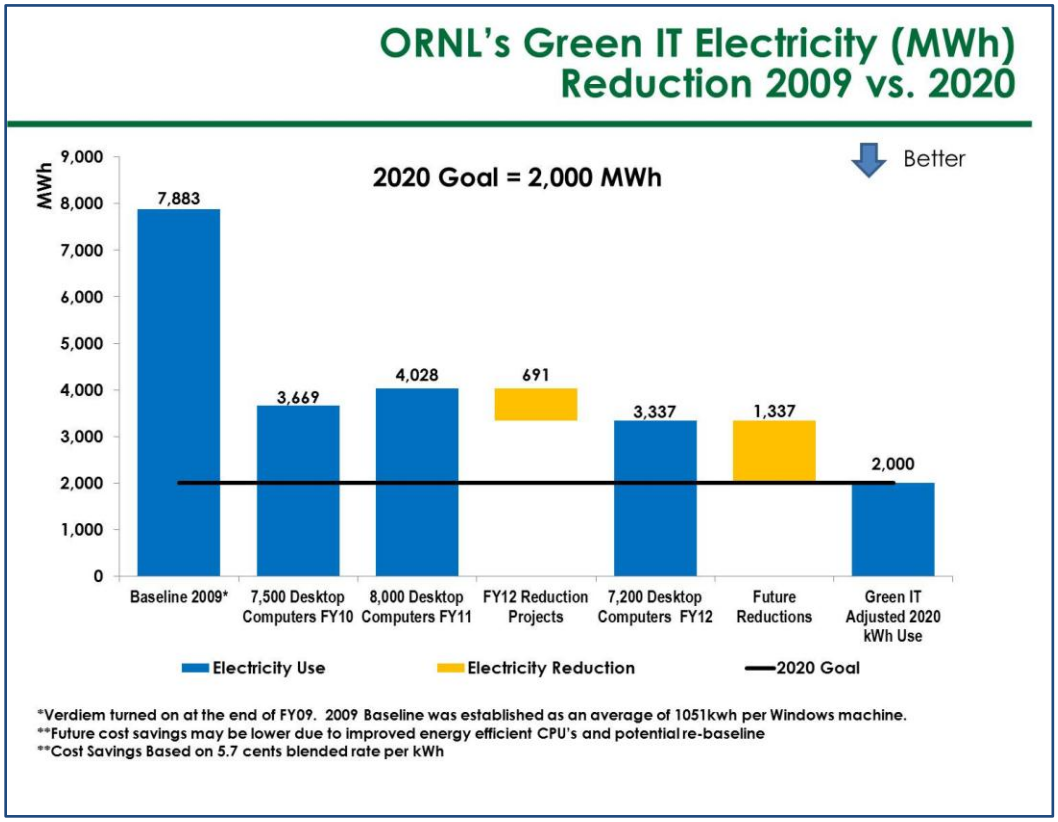


Figure 13. Waterfall chart showing the progression of electronic stewardship and electricity savings.

The following Green IT policies and procedures have been implemented by ORNL IT:

- ORNL IT offers standard computer hardware through a Managed Hardware Program (MHP). All computers, monitors, printers, and servers are required to be purchased through the MHP program, which offers only ENERGY STAR-compliant and/or EPEAT-certified equipment. All equipment offered is rated at Silver or Gold level. Exceptions to MHP standards require executive level approval.

- All desktop and laptop computers (Windows, Macintosh, and Linux) have mandatory Lab-wide screen saver policies set for 15 minutes.
- All windows desktops are required to be power managed. Verdiem services collect power usage data on all laptops, but are not used for managing power. Laptop power management is performed within the operating system by the user. Devices registered as instruments or servers are excluded from power management.
- Where possible, duplex printing is set as default on all print queues managed by ORNL IT.
- ORNL IT offers energy-saving power strips for all office equipment from the MHP site. The power strips sense when the computer is in sleep mode or powered off and then shuts off power to other devices plugged into the strip, such as scanners, printers, label makers, faxes, mobile device chargers, etc.

A printer assessment has been completed and a final business case and implementation plan has been developed for a Lab-wide printer contract and subsequent rollout. IT presented the network printer concept to the Lab Operations Council and Executive Management. Management has approved the printer project and fully supports our efforts to provide a Lab-wide shared printer contract. The printer contract will help the Lab standardize equipment, reduce energy consumption and landfill waste, reduce cost of operations, and provide more efficient use of consumable products. Initially, a printer pilot was to be performed with two vendors. After additional procurement review, the pilot was rolled into the Statement of Work to provide all vendors an equal opportunity to participate in the pilot. A Statement of Work was produced for bid and vendors have provided technical and cost proposals. We are currently reviewing the submitted proposals and continue to work with Lab Management for a path forward.

The ORNL IT organization has also contributed to developing several solutions for paperless electronic submissions for business systems at the Lab. The Export Control Office now stores all their documentation electronically within SharePoint as opposed to filing and tracking hard copies. Invoices can now be submitted online to Accounts Payable/Subcontract Associates, and a process to store electronic documents was put into place for the Contracts Division for requisitions, agreements, purchase orders, etc. In addition, ORNL's travel system was converted to a paperless solution where documents are stored in SAP's content server. All of these solutions have reduced paper consumption at the Lab and have improved business operations.

Plans and Projected Performance

ORNL's Green IT sustainable campus roadmap for FY 2013 includes the following:

- Completion and rollout of Verdiem 6.0 to support Mac power management and improved laptop provisioning
- Implementation of a user education campaign that focuses on minimizing local desktop printing at ORNL and encourages greater use of ORNL network printing
- Expanded use of server virtualization technologies across the Laboratory
- Expanded use of zero client computers and virtual desktops to take advantage of lower energy consumption, application virtualization, and data centralization to reduce the dependencies of using multiple computers for a single user

Barriers

There are no current barriers to meeting our objectives, but the following are potential impediments to achieving projected performance:

- Conflicting priorities for limited labor hours that would result in project delays
- Delayed printer contract award or issues with vendor start-up
- Budget constraints for labor and materials

Goal 8: Agency Innovation and Government-Wide Support

8.1 Site Innovation and Government-Wide Support

Site Innovation

The goal for innovation at ORNL is to help DOE maintain US global leadership in science, engineering, and energy management. ORNL will continue to research, develop, demonstrate, and deploy innovative solutions and initiatives to advance sustainability. Many of these developments will be deployed at ORNL in order to advance sustainability on the campus and, in parallel, demonstrate transportability. ORNL's diverse operational and research staff members are dedicated to achieving these goals, supporting a large number of innovative projects and initiatives. We are well positioned to demonstrate leadership in science, engineering, and energy management and to further advance sustainability in federal operations and scientific research.

Each project below will be considered based on feasibility, cost, and potential impact. For those considered feasible, on target, and potentially affordable, several funding mechanisms will be considered. Those potential mechanisms will include DOE support, Laboratory funding, and various forms of third party engagement.

Specific innovative projects under consideration include, but are not limited to, the following.

1. Support TVA's development of a SMR for dramatically reducing GHG emissions and paving the way for broader national use of this technology. ORNL plans, with DOE support, to work with TVA to support an SMR designed for at least 150 MW of capacity. This is expected to take the form of a DOE Power Purchase Agreement as security for a TVA/Industry consortium investment. DOE has agreed to fund design and engineering costs for this project with a location in Tennessee. ORNL and the Department will enjoy a 550,000 $MTCO_2e$ per year reduction in GHG emissions, satisfying an estimated 43% of DOE's Scope 1 and 2 reduction goals for FY 2020.
2. Pursuit of small pumped storage for reducing peak power demand. ORNL, via its TVA power contract, has an off-peak/on-peak power management opportunity. For every 2 MW of peak power reduction, ORNL can save $400,000 per year. In order to pursue this opportunity, ORNL is investigating the possibility of installing a pumped storage facility. The ORNL site has considerable topographic relief (~600 feet) and a TVA dam/reservoir adjacent to the site. These factors favor the possibility of using small pumped storage to offset the typical afternoon peaks in

power demand. Given that peaking power is a national grid issue, if proven cost-effective, we can pave the way for this technology being deployed in municipal, military, university, and industrial settings across the nation.

ORNL has completed a civil engineering study of this possibility and is preparing for a meeting with TVA for discussions on the business case and affordability. The early cost estimates indicate that the system is too costly for ORNL to pursue alone but discussions with TVA will frame possible joint solutions.

3. Installation of electric vehicle (EV) charging in order to introduce and advance acceptance of highway-ready EVs and demonstrate the use of renewable power, external battery storage, EVs, and the power grid all working together for maximum efficiency. ORNL has installed 25 solar-assisted EV charging stations and, is currently installing 19 non-solar-assisted charging stations including one DC fast charger. Last, 21 employees have acquired plug-in electric vehicles (Nissan Leafs, Chevy Volts, and Prius) and regularly charge them on campus during work hours. DOE has approved, during the research period ending September 2013, free charging for EV drivers. Research data is being collected and will be published for agency and public benefit.
4. Development of the Central Energy Data System, which will allow staff to collect, analyze, and easily access energy data for the entire campus and specific on-campus loads. This is giving management and staff the ability to make data-based decisions, find areas of best opportunity for energy reductions, and track performance with "drill-down" capability. In addition, this system will allow control of non-critical loads for peak power management. By necessity, the system is addressing cyber security concerns, IT infrastructure, and protocols for various meters. It will include data for grid-supplied electricity, water, renewable power, steam, EV charging, and natural gas. Last, the system will embrace high-speed grid meters for better understanding actual grid conductor performance, pointing us to areas of grid efficiency improvement. The system is installed and is functional as of September 2012. The next steps are to provide training and user access so the benefits of the system can be fully realized. This also becomes the heart of ORNL's on-campus smart grid which will benefit ORNL and can be readily transported to other settings.
5. Net zero energy buildings for the advancement of blending energy efficiency with renewable power. ORNL has a net zero energy building (Building 3156) on campus which has seen a 40% reduction in energy demand coupled with 67.7 MWh/year of solar-generated power. Going forward, ORNL will focus on LEED for existing buildings, HPSBs, and renewable power generation. This will provide experience on getting existing buildings to high performance standards while advancing renewable energy strategies.
6. Green gas generation as an option for renewable resource utilization. Green gas is renewable (landfill) gas that is injected into a pipeline near the point of generation and accounted for at that point. ORNL can purchase credits, burn an equivalent quantity of natural gas, and claim it as a renewable resource. We would use the green gas to drive a reciprocating engine and electrical generator. This project is now well defined and is ready for presentation of the business case and for seeking funding.
7. Telework programs to reduce employee commuting. SCI and Human Resources worked together to create a new Alternate Work Location policy (Telework) so employees could work from home up to two days each week. Currently 51 Telework Agreements have been processed. FY 2013 will include continued promotion of Teleworking and commuting by staff.

8. Further development and application of the Sustainable Campus Initiative in order to advance sustainability on campus and in external settings. ORNL has developed a transportable platform called the Sustainable Campus Initiative. It currently contains 26 roadmaps designed to lead ORNL to benchmark levels of sustainability by 2018. This effort began in 2008 and has evolved to its current state. In addition, we are beginning to use this platform off campus and have a Work for Others agreement in place with Indian River State College (IRSC) in St. Lucie County, Florida, for helping the IRSC implement their own "Sustainable Campus." We expect this to be the first of many external applications.
9. Development of regional sustainability process. Based on a successful Sustainability Summit held in the spring of 2011, ORNL has launched a Southeast regional process for advancement of sustainability. This grew from ORNL hosting a large (125-person) summit on sustainability (in March 2011) with a goal of speeding up the deployment of sustainable technologies. Tracks within the conference included vehicles and transportation, building efficiency, low-carbon power generation, strategic planning strategies, power grid strategies, and financing alternatives. The primary goal of the conference was to advance sustainability through sharing technologies and developing partnerships and specific plans for the future. ORNL plans a third Summit in the summer of 2013 and is actively pursuing the Southeast regional process.
10. Pursuit of "landfill methane" production from an anaerobic digester. Landfill gas (a source of renewable fuel) is produced from organic material decomposing in landfills, over time. This methane is tapped, scrubbed, and used locally or injected into a natural gas pipeline and is, by this process, accounted for as renewable fuel. The question is whether methane can be intentionally produced mechanically/chemically using biomaterials such as maize in a digester. An investigation is being conducted at ORNL to pursue this idea.

Wellness at ORNL – FY 2011/12

The goal of the ORNL Wellness Program is nothing short of transformative: to create a culture of wellness at ORNL that will:

- Keep the healthy people healthy
- Improve the health of those who are unhealthy
- Offer options that encourage all employees to engage in wellness
- Improve the campus environment to support employee engagement in wellness
- Flatten the healthcare cost trend for ORNL and our employees

The Wellness Program is pursuing these goals through the use of a wellness incentive program embedded with ORNL Benefits medical coverage. It consists of a comprehensive Reward Points Program (RP) for engaging in healthy activities and an annual Health Assessment (HA). Table 14 indicates total numbers of completions in each component of the wellness incentive since the beginning of the program in 2007. Those eligible for the incentive include our salaried employees who are the primary policyholder of their ORNL medical coverage. In FY 2007 and FY 2008, completing the HA was the only requirement of the Wellness Incentive to earn a $20 monthly reduction in ORNL medical premiums. In FY 2009 the RP was added along with an increase in the incentive to a $30 monthly reduction in medical premiums with completion of both the RP and HA. Participation numbers decreased with the addition of the Rewards Points Program; however, we are still maintaining a 74% completion rate, significantly above the rate of

the average client served by our wellness partner (Mayo Clinic). Table 14 shows preliminary results for 2012, an estimated increase of 11% from 2011. Aggregate results from Mayo are due in January.

Table 14. ORNL Wellness Plan with preliminary 2012 results

	2007 $20 HA	2008 $20 HA	2009 $30 RP+	2010 $30 RP+	2011 $30 RP+	2012 $30 RP+
Wellness Incentive	2017	2729	2027	2308	2265	2489
Reward Points Completion	NA	NA	1946	2223	2351	2525
HA Completion	2563	2790	2399	2611	2410	2715
Eligible Population	3256	3359	3548	3653	3616	3350
ORNL Total Population	4229	4447	4612	4867	4625	4372

The ORNL Wellness Program offered for the fifth full year the Mayo Clinic Health Assessment and for the third year the Reward Points Plus Program. A total of 2,489 employees completed the Health Assessments, the same as in 2010 with 74% of the eligible employees (3,350, no hourly workers included). The cohort data indicates favorable movement was observed for all health status categories. ORNL's 2007–2011 cohort shows an increase in population at low and moderate risk, and a decrease in high and very-high risk. Cohort risk dropped in 9 of 11 risk categories.

In October 2011, the ORNL Wellness Programs continued to support the Reward Points Program with the Health Series lectures, screenings, and challenges/programs. Under this umbrella, the Wellness Program provided the annual Benefits and Wellness Fair along with two monthly health series to create awareness and to education the ORNL population on the most prevalent risk factor at ORNL. Employee attendance in most sessions exceeded 2010/11 attendance rates. Lectures included such topics as "Seasonal Eating," "Lifestyle Changes to Lower Hypertension," "Benefits of Eating Sushi," and "Preventing Diabetes," to name a few. Table 15 lists the topics of the lectures, screenings, or challenges along with the number of sessions conducted and the number of employee participants in FY 2012.

Table 15. Lectures, screenings, and challenge programs with participation results
[– numbers of sessions (participants)]

Lectures	Screenings	Challenges/Programs
Nutrition – 5 (484)	Skin Cancer – 1 (163)	Biggest Loser – 2 (502)
Stress – 12 (823)	PSA – 1 (60)	Santaclaustrophobia – 1 (668)
Medical Risks Factors – 6 (390)	Mammogram – 7 (212)	Beach Physique – 1 (399)
Physical Fitness – 37 (1898)	Biometrics – 3 (313)	Walk to Wellness – 1 (223)
Sprains/Strains – 2 (83)		
Sleep – 1 (125)		

The ORNL Wellness Program conducted two sessions of the Biggest Loser Contest, a 10-week weight management program, and saw tremendous success. The first session consisted of about 300 ORNL employees with 52 teams losing a combined 2,510 lb, a little more than a ton of weight. The male with the highest percentage of weight loss lost 24% of his body weight, and the female with the highest percentage of weight loss lost 13.4%. With losing 10% of an individual's body weight comes many health

benefits, and most health risk factors disappear, such as high blood pressure, diabetes, heart disease. Other notables include several teams that lost more than 100 lb of combined weight. Thirty individuals lost 10% or more of their body weight.

In the second round of the Biggest Loser Program, 46 teams with 228 employees participated, with 13 individuals losing 10% or more of their body weight. Two teams lost over 100 lb, and many of the employees were participating for the second time in the Biggest Loser Contest. Personal benefits of weight loss (from participant testimonials) included reduced joint pain and inflammation, less acid reflux, lower blood pressure, lower blood sugar levels, easier breathing (not as winded climbing stairs), better sleep (improved sleep apnea), and increased energy.

High blood pressure is a very prevalent medical risk factor here at ORNL. With this knowledge, the ORNL Sustainability Campus Initiative and ORNL Wellness Program partnered to add three additional (totaling five) self-service blood pressure stations on the ORNL campus and off-site. One is located on the west campus in the lobby of Building 1505, another is located on the second floor of the National Transportation Research Center, and the third is at the High Flux Isotope Reactor/Radiological Engineering Development Center. Other stations are located at SNS near the cafeteria and in Building 5700. The blood pressure machines are self-service so that employees can check their own blood pressure any time. Since the machines were installed in late October 2011, 3,588 (machine at SNS) and 5,652 (machine at B5700) blood pressures have been checked on the machines; other statistics include 642 (machine at NTRC), 503 (machine at 1505), and 144 (machine at HFIR) blood pressures checked.

The ORNL Wellness Program has received several awards notifications, one being the "Shining Star" award through The Tennessee Governor's Council on Physical Fitness and Health. We also received an EFCOG recognition award for the work on the Health & Productivity Management Programming Best Practices document, a joint effort of all DOE Labs wellness and health promotion program managers.

Oak Ridge Reservation Sustainability in Natural Resources Management and ORNL Landscaping

ORNL lies within a fairly undeveloped eastern deciduous forested area (part of the 33,000 acre Oak Ridge Reservation). Landscaping at ORNL is using the surrounding healthy forest ecosystem as a model with the objective of increasing ecosystem services provided onsite through the landscaping. Ecosystem services are identified using the Sustainable Sites Initiative definitions.

FY 2012 actions included the development of a generic riparian landscape plan; publication of the updated ORNL campus landscaping plan (and putting it online for internal and public access); installing interpretive signs for the rain gardens, edge habitat, and riparian landscaped areas; and landscaping priority areas.

FY 2013 actions include establishing a long-term maintenance plan for the Swan Pond, identifying and preparing plans for wetland enhancements that could be considered if mitigation is needed, and preparing information regarding the benefits landscaping has provided in storm water management.

UT-Battelle/ORNL manages the natural resources on the 33,500 acre DOE Oak Ridge Reservation (ORR) for DOE. A draft Forest Management Plan was prepared in September 2012 and includes these sustainable approaches:

- Development of integrated pest management plants for monitoring of forest pests such as hemlock wooly adelgid, emerald ash borer, thousand canker disease, gypsy moth, etc.; consideration of options; and prioritization of treatments
- Identification, enhancement, and protection of special plant and wildlife habitat such a migratory bird habitat, wetlands, and native grass/meadow communities
- Planning, prioritization, and treatment of invasive plant infestations
- Sequestering of carbon in forests and soils

Community/Regional Involvement

A partnership among Oak Ridge City, Anderson County, Tennessee Exotic Pest Plant Council, UT Forest Research Center, TN Citizens for Wilderness Planning, and ORNL sponsored a community workshop "Dealing with Invasive Plants" in September 2012. More than 50 landowners and professional grounds staff attended. Presentations included information on how to identify invasive plants, how to develop a plan, native alternatives to invasive plants, and two break-out sessions targeted at community issues (homeowners) and leveraging resources in dealing with larger areas (professionals).

Integration of Pest Management Practices

ORNL has implemented an integrated pest management program that includes an Indoor Integrated Pest Management Program (IPM) and an Exterior Integrated Pest Management Program (EPM). The IPM program focuses on pest management inside buildings and facilities. The EPM program consists of two programs, one that focuses on the areas around buildings and structures and a Reservation Integrated Pest Management Program (RPM) for the Oak Ridge Reservation.

Interior Integrated Pest Management Program (IPM)

- The goal of the IPM is to reduce the exposure of building occupants and maintenance personnel to potentially hazardous chemical, biological, and particulate contaminants that adversely affect air quality, human health, building finishes, building systems, and the environment while controlling infestations of insects and rodents.
- The IPM is a process for achieving long-term, environmentally sound pest suppression and prevention through the use of a wide variety of technological and management practices. Control strategies are intended to extend beyond the application of pesticides to include structural and procedural modifications that reduce the food, water, harborage, and access by pests.
- A service contact is in place with Cook's Pest Control to support the IPM. The contract is written to incorporate best practices from the US Green Building Council's LEED for Existing Buildings program. The contract includes environmental controls such as ensuring that all cracks and holes are sealed to minimize pathways for pests to enter a building; educating building occupants as to the importance of good housekeeping regarding food storage, waste collection and plant maintenance; mechanical controls such as uses traps and removing webs and nests (except bird nests, which are not removed until they are no longer being used); organic and non-pesticide

controls such as sticky traps and using vacuums to remove infestations; and chemical controls, which will be used as a last resort to control pests.
- As the IPM is implemented, it is expected that less chemical control will be needed.

Exterior Integrated Pest Management Program (EPM)

- The goal of the EPM is to reduce the exposure of building occupants and maintenance personnel to potentially hazardous chemical, biological, and particulate contaminants that adversely affect air quality, human health, building finishes, building systems, and the environment while controlling infestations of insects and rodents. This goal was developed to comply with the US Green Building Council's LEED for Existing Buildings program. The plan defines best management practices to support the significant reduction in the use of harmful chemicals to control insects and rodents.
- The EPM is a process for achieving long-term, environmentally sound pest suppression and prevention through the use of a wide variety of technological and management practices. Control strategies are intended to reduce the need for chemical application and include: Environmental, Mechanical, Organic and Chemical Controls.
- A service contact is in place with Cook's Pest Control to support the EPM. The contract is written to incorporate best practices from the US Green Building Council's LEED for Existing Buildings program. The contract includes environmental controls such as ensuring that all cracks and holes are sealed to minimize pathways for pests to enter a building, ensuring that landscaping is maintained properly and destroying nesting sites; educating building occupants as to the importance of good housekeeping to minimize waste accumulation around a facility; mechanical controls such as using traps and removing webs and nests (except bird nests, which are not removed until they are no longer being used); organic and non-pesticide controls such as sticky traps, using organic pest controls and using vacuums to remove infestations; and chemical controls, which will be used as a last resort to control pests.
- As the EPM is implemented, it is expected that less chemical control will be necessary, resulting in the reduction of quantities of applied chemicals.

III. Climate Change Adaptation

ORNL is very actively engaged in climate adaptation research and modeling. This is accomplished by utilizing the extensive computational capability of the Laboratory, combined with scientific excellence in adaptation and mitigation analysis. In particular, since 2007 DOE's Integrated Assessment Research Program (IARP) has engaged ORNL in strengthening the capacity of Integrated Assessment Research in general and Integrated Assessment Modeling in particular, to address questions about possible impacts of climate change and possible adaptive responses. As an extension of the IARP effort, ORNL, in collaboration with Los Alamos National Laboratory, has received a scope augmentation of the Assistance with Incorporating Impacts into Integrated Assessment project to (1) strengthen the capacity to analyze climate change impacts of and responses to climate change of built infrastructures in the United States, linked to ongoing integrated assessment modeling efforts; (2) improve capacities to explore and understand issues of infrastructure vulnerability and fragility as climate change combines with other system stresses; and (3) connect with, inform, and be informed by other DOE critical infrastructure

activities of interest to DOE. This project was funded for $500 thousand in FY 2011, and $700 thousand per year in FY 2011, and $1 million in FY 2012. The FY 2013 budget is yet to be determined. Tom Wilbanks is the Principal Investigator.

While the above-described research is an ongoing program of the Laboratory, it is not aimed at specific changes to the local site infrastructure. However, many of the roadmaps within the Sustainable Campus Initiative are responsive to the adaptation issue and are informed by the Laboratory's knowledge of issues and options. For example, several of the roadmaps will positively affect GHG emissions, reducing dramatically, if successful, ORNL's carbon emissions. ORNL has the opportunity to become a net zero carbon facility if the SMR project and other roadmaps are fully successful. In addition, several of the roadmaps will improve energy efficiency, again reducing the severity of climate change.

Last, ORNL is not particularly exposed to some of the traditional adaptation risks such as rising sea levels or increases in the number of hurricanes, although East Tennessee is vulnerable to other types of severe storm events such as tornadoes. The most serious regional concern is with prospects for increases in the frequency and severity of seasonal heat waves and/or droughts. In these connections and others, ORNL has a very detailed disaster response plan for facilities and employees should the frequency or severity of climate-related events rise in the future.

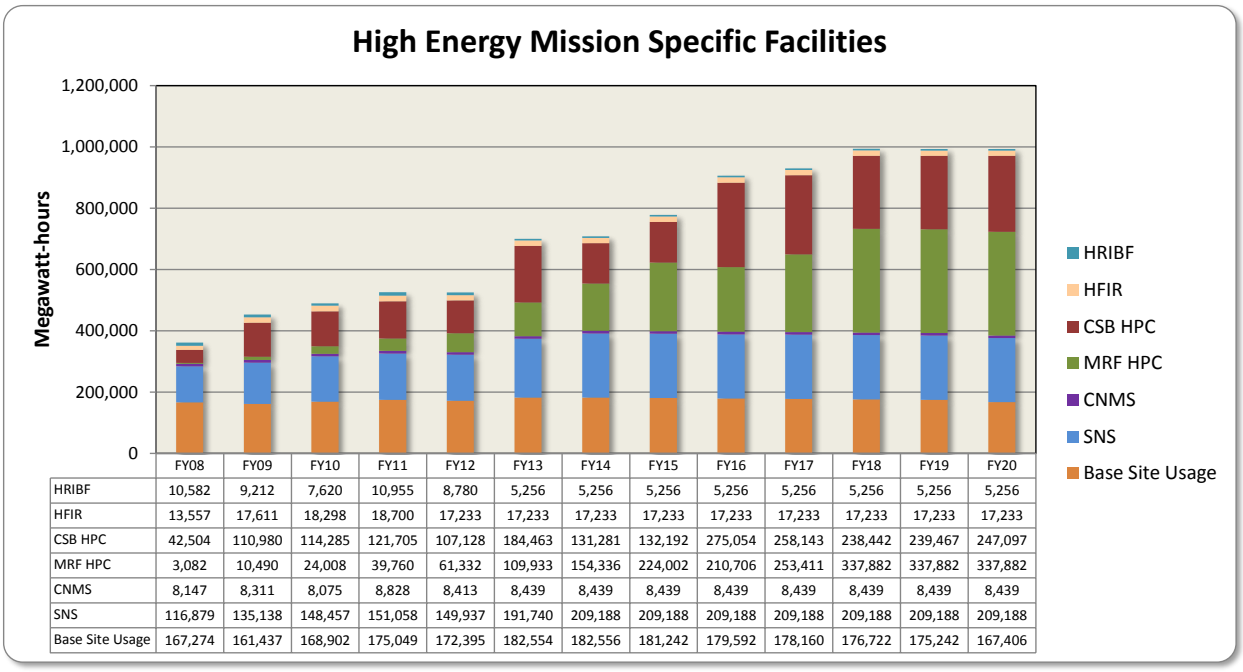
IV. Projected Electrical Use & High Energy Mission-Specific Facilities (HEMSFs)

ORNL has defined six facilities as High Energy Mission-Specific Facilities (HEMSFs). Those facilities use a substantial portion of ORNL's total electrical power. In FY 2008 they used over 187,000 MWh, over half of all ORNL power. By FY 2020 ORNL's HEMSFs are projected to use approximately 819,000 MWh and over 80% of all ORNL power.

Figure 14 illustrates the historical and projected power consumption for ORNL's HEMSFs as well as the base site usage such as general offices and labs. Total electricity consumption is expected to increase by 174% from a FY 2008 baseline. All ORNL HEMSFs are designated in the DOE Facility Information Management System (FIMS) database as "excluded" facilities; that is, their energy use is excluded from calculations that track progress towards energy intensity reduction goals. The facility definitions are listed below, and a brief narrative describing each facility follows.

Definitions and Identification of ORNL HEMSF:

HRIBF	Holifield Radioactive Ion Beam Facility	Accelerator
HFIR	High Flux Isotope Reactor	Fission reactor
CSB HPC	Computational Sciences Building	High performance computing
MRF HPC	Multiprogram Research Facility	High performance computing
SNS	Spallation Neutron Source	Accelerator
CNMS	Center for Nanophase Materials Sciences	Nano-science facility
Base Site Usage	Power usage in addition to that of HEMSFs	Offices/labs/support



	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20
HRIBF	10,582	9,212	7,620	10,955	8,780	5,256	5,256	5,256	5,256	5,256	5,256	5,256	5,256
HFIR	13,557	17,611	18,298	18,700	17,233	17,233	17,233	17,233	17,233	17,233	17,233	17,233	17,233
CSB HPC	42,504	110,980	114,285	121,705	107,128	184,463	131,281	132,192	275,054	258,143	238,442	239,467	247,097
MRF HPC	3,082	10,490	24,008	39,760	61,332	109,933	154,336	224,002	210,706	253,411	337,882	337,882	337,882
CNMS	8,147	8,311	8,075	8,828	8,413	8,439	8,439	8,439	8,439	8,439	8,439	8,439	8,439
SNS	116,879	135,138	148,457	151,058	149,937	191,740	209,188	209,188	209,188	209,188	209,188	209,188	209,188
Base Site Usage	167,274	161,437	168,902	175,049	172,395	182,554	182,556	181,242	179,592	178,160	176,722	175,242	167,406

Figure 14. Historical and projected electricity consumption including HEMSF and ORNL base site usage.

Summary and Update on Electrical Projections

The HRIBF programs have experienced a reduction in funding, resulting in decreased research activities and a reduction of approximately 20% in energy consumption. Unless additional funding is identified, continued decreases in research predict a 40% reduction in energy consumption in FY 2013 and beyond. The CSB and MRF High Performance Computing project expects significant growth moving forward. Beginning in FY 2013, ORNL's High Performance Computing will increase 70%. The Spallation Neutron Source is expected to increase research activities in FY 2013 and beyond.

Holifield Radioactive Ion Beam Facility

The ORNL Holifield Radioactive Ion Beam Facility (HRIBF) was operated as a National User Facility for DOE from 1996 to 2011, producing high-quality beams of short-lived, radioactive nuclei for studies of exotic nuclei and astrophysics research. These nuclei are produced when intense beams of light ions from the Oak Ridge Isochronous Cyclotron (ORIC) strike highly refractory targets. The radioactive isotopes diffuse out of the production target and are ionized, formed into a beam, and mass selected. This technique of radioactive ion beam production is known as the isotope separator on-line (ISOL) technique. The radioactive ion beam is then injected into the 25-MV Tandem, the world's highest voltage electrostatic accelerator. The HRIBF scaled back research to

match a reduction in funding in FY 2012. The research reduction is expected to continue until additional programmatic funds are identified.

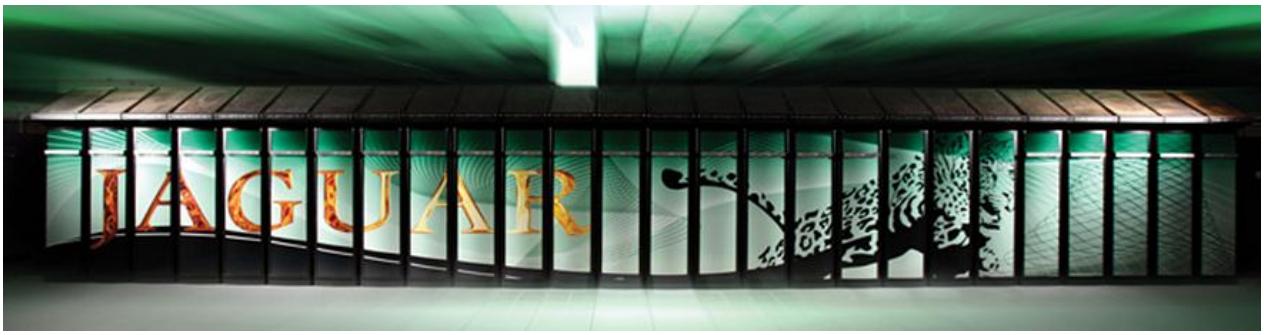
High Flux Isotope Reactor

Operating at 85 MW, the ORNL High Flux Isotope Reactor (HFIR) provides one of the highest continuous fluxes of neutrons of any research reactor in the world, and its cold source is the brightest in the world. The neutron scattering research facilities at HFIR contain 15 world-class instruments either in operation or planned, including two cold source instruments. The thermal and cold neutrons produced by HFIR allow scientists to study the molecular and magnetic structures and behavior of a variety of materials, including high-temperature superconductors, polymers, metals, and biological samples. These studies are leading to scientific and technical advances in a wide range of fields, such as physics, chemistry, materials science, engineering, and biology. The reactor is also used for isotope production, materials irradiation, and neutron activation analysis.

Computational Sciences Building and Multiprogram Research Facility – High Performance Computing

The Oak Ridge Leadership Computing Facility (OLCF) was established at ORNL in 2004 with the mission of standing up a supercomputer 100 times more powerful than the leading systems of the day.

In November 2012, the Titan at ORNL was awarded the world's fastest computer at 17.59 sustained petaflops, exceeding IBM-powered Sequoia at 16.32 petaflops, for the second fastest computer award. Titan is ten times more powerful than its predecessor, the ORNL Jaguar, once at the top of the fastest computer list with 2.3 petaflops. Titan's capacity is rated at 20 petaflops or a quadrillion calculations per second, powered by 18,688 Nvidia Tesla K20X GPUs and over 560,640 AMD processors. Titan will be used to simulate complex models of climate change, to analyze nuclear reactions and alternative energies, and to develop the next generation of materials used to manufacture US goods. Titan's graphical processing units and central processing units will occupy the same space as Jaguar with only marginally more electricity, lowering ORNL's carbon footprint.



As a result, the OLCF gives the world's most advanced computational researchers an opportunity to tackle problems that would be unthinkable on other systems. The facility welcomes investigators from universities, government agencies, and industry who are prepared to perform breakthrough research in climate, materials, alternative energy sources and energy storage, chemistry, nuclear physics, astrophysics, quantum mechanics, and the gamut of scientific inquiry. Because it is a unique resource, the OLCF focuses on the most ambitious research projects—projects that provide important new knowledge or enable important new technologies.

Looking to the future, the facility is moving forward with a roadmap that by 2018 will deliver an exascale supercomputer—one able to deliver 1 million trillion calculations each second. Along the way, the OLCF will stand up systems of 20, 100, and 250 petaflops.

Spallation Neutron Source (SNS)

SNS is an accelerator-based neutron source that provides the most intense pulsed neutron beams in the world for scientific research and industrial development. SNS is a versatile scientific tool that gives researchers more detailed snapshots of the smallest samples of physical and biological materials than ever before possible. With the suite of eventually 25 best-in-class instruments, scientists can count scattered neutrons, measure their energies and angles at which they scatter, and map their final positions. SNS allows measurements of greater sensitivity, higher speed, higher resolution, and in more complex sample environments than ever before. The diverse applications of neutron scattering research are providing opportunities for research on the structure and dynamics of materials in practically every scientific and technical field.

Center for Nanophase Materials Sciences

The Center for Nanophase Materials Sciences (CNMS) is co-located with the Spallation Neutron Source on Chestnut Ridge of the ORNL campus. The CNMS encompasses expertise and instrumentation for user research in a broad range of disciplines selected to address forefront research in nanoscience, nanotechnology, and phenomena. The CNMS integrates nanoscale science with neutron science; synthesis science; and theory, modeling, and simulation. The facility is equipped with a wide range of specialized tools for synthesis, characterization, and fabrication of nanoscale materials and assemblies, including the integration of hard and soft materials.

V. Budget/Funding

ORNL assesses environmental, economic, and social benefits of proposed activities on an individual, project-specific basis. Through the Mission Readiness process, ORNL determines the ability of its facilities and infrastructure to accomplish mission objectives now and in the future. Projects are identified to further the safe, compliant, efficient accomplishment of mission objectives including sustainable operations. Funding sources for projects are evaluated and established, taking into consideration all available and appropriate funding venues including private sector financing, cost sharing, institutional investment, and programmatic appropriations. Allocation of funds is based on multiple considerations including mission impact, sustainability, and return on investment (ROI).

Performance Status

Large-scale projects undergo a unique assessment. ORNL implements DOE Order 413.3B, the requirements of which include analyses of alternatives, justification/strategic need, economic considerations, technical and operational considerations, environmental impact, energy conservation, sustainable design, waste minimization, value engineering, and risk assessment.

ORNL has deployed the Sustainable Campus Initiative, the goal of which is to achieve benchmark sustainability in campus operations and in the research, development, and deployment of key technologies. The time frame for implementation of the initiative is ten years, with emphasis on near-term improvements. Funding determination for specific projects and actions under the Initiative assess the potential environmental, economic, and social benefits of each measure.

The Initiative currently contains more than 20 dynamic roadmaps at varying stages of implementation. Each roadmap has specific fiscal year deliverables that are kept on schedule through regular (often bi-weekly) review meetings held between individual roadmaps owners and the leadership of the Initiative. In addition, the Director of Facilities and Operations (an Initiative Sponsor) has made success on these roadmaps a part of his department’s performance plan.

In addition, all roadmaps are reviewed with the Sustainable Campus Initiative sponsors (from the ORNL Leadership Team) on a quarterly basis. This provides an opportunity for the sponsors, and others invited, to question the viability and merit of any project and provide guidance going forward. Certain projects undergo close financial scrutiny while others may be supported directionally until more facts are available.

For example ECMs are screened by facility managers and engineers before being selected. In addition to technical and energy savings feasibility, each project is analyzed in terms of financial return. The majority of the projects considered as good candidates for ECMS have a financial payback estimate of less than two years.

Plans, Actions, and Projected Performance

ORNL will continue current practices to identify, assess, fund, and implement projects that are designed to address mission needs while advancing federal leadership in energy, environmental, and sustainability practices.

For a major projects, thorough and multiple financial analyses are conducted, including expected power production from the project vs. expected purchased power cost, payback time on DOE investment, risk considerations, and net present value (NPV) of various options.

The following business cases have been developed or are in progress:

- In October 2011, ORNL compiled a business case demonstrating a DOE cost share whereby TVA would supply SMR power to ORNL and other DOE-OSO locations. The initial analysis consisted of an initial assessment of the economic viability and environmental benefit of construction and operation of a first-of-a-kind commercial SMR in the TVA region. The SMR project is intended to provide the means for addressing both energy independence and the potential for advanced deployment of carbon-free emissions. The analysis concluded that construction of an SMR would
    - allow the Office of Science to significantly reduce GHG emissions while allowing for vital mission growth
    - allow DOE to meet a major portion of the department-wide goal for GHG reductions
    - provide ORNL with long-term, stable, and cost-competitive electricity for continued and expanded missions
    - pave the way for broad use of SMR technology, giving the nation another key tool for reducing its dependence on fossil fuels.

  The technical and economic aspects of the SMR continue to be evaluated at the appropriate levels of DOE and TVA. ORNL is prepared to support further evaluation and planning for the SMR and any related alternatives at such time as DOE and TVA determine a path forward.
- In consideration of the advancement of solar technology, relevant factors include the market value of Renewable Energy Certificates, the cost of solar power vs. purchased power, and a comparison with other technologies available for meeting renewable energy goals. Funding alternatives include direct DOE investment, leasing the facilities from an external party, and establishing a Power Purchase Agreement with an external party who would make the necessary investment. At this time, the relatively high cost and long-term payback associated with a large solar array (i.e., one megawatt or larger) are considered prohibitive in comparison to other

renewable energy alternatives. ORNL will continue to implement and operate smaller solar units where feasible and to consider larger opportunities as solar technology continues to progress.

- FY 2012: A business case was completed for the procurement and operation of a two-megawatt-capacity natural gas internal combustion generator to produce electricity by burning landfill natural gas. The DOE O 430.2B goal of providing 7.5% of the site's electrical consumption from renewable energy sources beginning in FY 2013 is reduced by one-half if the electrical energy is generated on-site. It is therefore estimated that a two megawatt generator would address at least 50% of this goal based on ORNL's projected total electricity usage in FY 2014. This generating capacity also would allow ORNL to offset utility demand and energy cost, develop backup power capability for its high performance computing systems, and potentially provide waste heat to building hot water systems. In addition to procurement and installation, cost criteria evaluated included cost of capital, operating costs net of costs avoided by reducing power (and associated carbon emissions) from other sources, and the cost and market value of Renewable Energy Certificates (RECs).

  Depending on the availability and prioritization of funding, ORNL is currently considering incorporation of the two megawatt generator into the 7000 Area revitalization plans. Installing the generator as the first phase of a 7000 Area Energy Park could provide the following long-term benefits:
  - The generator would be a highly visible statement of DOE and ORNL's commitment to green energy.
  - Green gas electricity generation with combined heat and power would enable the demonstration of energy leadership by meeting the majority of ORNL's renewable electricity mandate while limiting the purchase of RECs.
  - Waste heat recovery along with an associated Thermal Energy Park potentially could provide building space heat in the winter and reheat in the summer.
  - An Energy Park would provide additional opportunities for future development of a utility-scale solar farm and renewable resource integration research.
  - A Visitor Center/Control Room could provide an energy showcase for public viewing of green energy utilization and generation.
- FY 2012: A business case was completed for construction and operation of a new power substation near the East Campus area of ORNL. The new substation would provide increased overall reliability and efficiency in distributing power to the diverse research, support, and high performance computing missions conducted across ORNL. Rapidly escalating high performance computing power requirements are a primary and immediate driver for the new substation. Major cost factors include design and construction, cost of capital, payback period, and evaluation of funding alternatives based on benefits to impacted programs. Cost savings should be realized from reduced line losses, as well as potentially less operations and maintenance cost, due to transmission of power over shorter distances.

  Discussions have been held with DOE, TVA, and impacted programmatic customers with tentative agreement reached to proceed with planning and construction of the new substation. TVA and DOE are currently finalizing the agreement.
- FY 2012: A business case study was initiated to consider altering ORNL's chilled water system for the Computational Science Building (5600). The study investigates efficiency, water usage,

and satisfying cooling requirements for the post-Titan generation of high performance computing (i.e., OLCF-4 in the 2015–2016 timeframe and the Exascale machine in approximately 2020). Alternatives under study include the construction of a new traditional chilled water plant, construction of a lake water plant using natural chilled water from Melton Hill Lake, and a combination of the lake water plant and an existing ORNL chilled water plant. Advantages associated with using lake water for chilling include:

- potentially large reductions in the amount of needed electricity (and associated reduction in carbon emissions)
- potentially large reductions in the amount of purchased water
- potentially large reductions in the amount of chemicals and used water (i.e., blow down discharged to creeks)
- demonstrates utilization of a readily available renewable resource.

Smaller strategic projects, such as employee engagement and waste reduction, are funded, recognizing the impact on employee behavior, GHG emissions, and the general sustainability of the campus. Other projects may be funded on a demonstration basis, but always with a belief that they offer sufficient probability of success to warrant early support.

Barriers

Specific barriers are included in the discussions and summary statements of status and planned path forward and are included in this section for each business case as discussed.

In general, major barriers to success include lack of available funding or conflict in prioritization when balancing funding requirements for sustainability projects vs. research and research support programs; delays in final decision and approval by ORNL and DOE management due to the time required to fully analyze and resolve technical and funding issues; and in the case of third-party involvement such as for the East Campus power substation, delays in obtaining and finalizing competitive and satisfactory terms for financing.

Regularly scheduled reviews with Sustainable Campus Initiative sponsors and the ORNL Leadership Team, as discussed above under Performance Status, are intended to maintain the proper focus to facilitate prioritization and decision making to meet critical path project objectives while at the same time considering the organizations' overall budget and funding positions.

List of Acronyms

AFV	Alternative fuel vehicle
ARES	Advanced Reciprocating Engine Systems (DOE program)
ARRA	American Recovery and Reinvestment Act
AVID	Accelerated Vendor Inventory Delivery
AWA	Alternative Workplace Agreements
AWH	Alternate work hour
BOA	Blanket ordering agreement
BTU	British thermal unit
C&D	Construction and demolition
CEDR	Consolidated Energy Data Report
CRAC	Computer room air conditioner
DOE	US Department of Energy
EC	energy consuming
ECM	Energy conservation measures
EISA	Energy Independence and Security Act
EO	Executive Order
EPA	US Environmental Protection Agency
EPACT	Energy Policy Act
EPP	Environmentally Preferred Products
ESCO	Energy service company
ESPC	Energy savings performance contract
EUI	Energy use intensity
EV	Electric vehicle
F&O	Facilities and Operations Directorate
FAR	Federal Acquisition Regulations
FAST	Federal Automotive Statistical Tool
FIMS	Facilities Information Management System
G/GSF	Gallons per gross square foot
GGE	Gasoline gallon equivalent
GHG	Greenhouse gas
GI/LID	Green infrastructure and low-impact development
GP	Guiding principle
GPY	Gallons per year
GSA	General Services Administration
GSF	Gross square feet/Gross square footage
GWP	Global warming potential
HEMSF	High energy mission specific facility
HFIR	High Flux Isotope Reactor
HPSB	High performance sustainable buildings
HQ	Headquarters
HRIBF	Holifield Radioactive Ion Beam Facility

HVAC	Heating, ventilating, and air conditioning
ILA	Industrial, landscaping, and agricultural
IT	Information technology
JCI	Johnson Controls, Inc.
KAT	Knoxville Area Transit
kW/kWh	Kilowatt/kilowatt hour
LEED	Leadership in Energy and Environmental Design
LEED AP	Leadership in Energy and Environmental Design Accredited Professional
LSV	Low-speed vehicle
MGY	Million gallons per year
MHP	Managed Hardware Program
$MTCO_2e$	Metric tons, carbon dioxide equivalent
MVSP	Melton Valley Steam Plant
MW/MWh	Megawatt/Megawatt hour
NEPA	National Environmental Policy Act
OLCF	Oak Ridge Leadership Computing Facility
ORNL	Oak Ridge National Laboratory
OSO	Oak Ridge Site Office (of DOE)
OTC	Once-through cooling
P2	Pollution Prevention Program
PPA	Power purchase agreement
PUE	Power utilization effectiveness
PV	Photovoltaic
R&D	Research and development
RE	Renewable energy
REC	Renewable energy credit
SF	Square feet
SF_6	Sulfur hexafluoride
SMR	Small modular reactor
SNS	Spallation Neutron Source
SPO	Sustainability Performance Office
SSP	Site Sustainability Plan
SSPP	Strategic Sustainability Performance Plan
T&D	Transmission and distribution
TVA	Tennessee Valley Authority
USS-PV	Utility-scale solar photovoltaic
VAV	Variable air volume
VFD	Variable flow devices

Appendix A

ORNL Self-Certification Form for the Energy Intensity Goal

DOE BUILDING EXCLUSION
SELF-CERTIFICATION FORM
FY 2012

FROM: Oak Ridge National Laboratory
Johnny O. Moore, Manager
Oak Ridge Site Office

TO: Sustainability Performance Office

DATE: November 30, 2012

SUBJECT: Self-Certification Form for the Energy Intensity Goal of EIAS 2007

Each buildings or group of buildings excluded under the criteria for a Part G or Part H exclusion is/are metered for energy consumption and their consumption is reported annually.

No buildings have been excluded under Part H. If they had been, then all practicable energy and water conservation measures with a payback of less than 10 years would have been installed. A justification statement explaining why process-dedicated energy in the facility may impact the ability to meet the goal would have been provided in the FIMS Report 063.

I certify that the buildings listed on the Excluded Buildings List produced by FIMS as Report 063 dated 15 November 2012 for Oak Ridge National Laboratory and listed on pages 2 through 5 below meet the exclusion criteria in *Guidelines Establishing Criteria for Excluding Buildings* published by FEMP on January 27, 2006.

Johnny O. Moore
_____
DOE Site Office Official – printed name

_____
DOE Site Office Official – signature

_____
Date

Contact:
Mary H. Rawlins
Federal Project Director
Phone: (865) 576-4507
eMail: rawlinsmh@ornl.gov

Name of Building(s) from FIMS data base (Property Name)	FIMS - Property Sequence Number	Part (check one)							Comments
		B	C	D	E	F	G	H	
161 kV Substation	0901						X		This is a primary substation for ORNL electrical power. Electrical loss across transformers is inherent in their design. Energy loads are not influenced by conventional building energy conservation measures.
Computer Center (part of Multi-Program Research Facility)	5300						X		This is a relatively new (2008) high performance computing center in the Multi-Program Research Facility. Energy is required for computational science and other missions, and energy intensity in the data center is 13 times that of standard buildings at ORNL. Significant energy reductions are not practical without affecting mission operations.
Computer Center (part of Computational Sciences Building)	5600						X		This is a relatively new (2003) modern facility with a high performance computing center. Energy is required for computational sciences research missions (i.e., supercomputing), and energy intensity in the data center is 32 times that of standard buildings at ORNL. Significant energy reductions are not practical without affecting research operations.

Holifield Heavy Ion Research Facility	6000						X		The energy is required to support the facility's research mission. The facility incorporates 2 accelerators and a high-voltage isochronous cyclotron generator to create various radioactive ion beams for research targets. The facility's energy intensity is about twice that of standard buildings at ORNL. Energy loads are not influenced by conventional building energy conservation measures. Significant energy reductions are not practical without affecting research operations.
161 kW Substation	7640						X		This is a primary substation for ORNL electrical power. Electrical loss across transformers is inherent in their design. Energy loads are not influenced by conventional building energy conservation measures.
Waste Processing Facility process buildings, as follows:	*See comment at right:*								The Waste Processing Facility (WPF) buildings listed below make up the process buildings required for transuranic (TRU) waste processing. Energy is required for the operations mission. The facility's energy intensity is about 60% higher that that of standard buildings at ORNL. Significant energy reductions are not practical without affecting TRU waste processing activities.
Waste Processing Facility	7880						X		--- see WPF comment above ---
WPF Control Room	7880D						X		--- see WPF comment above ---
WPF Boiler	7880E						X		--- see WPF comment above ---
WPF Air Compressor	7880F						X		--- see WPF comment above ---
WPF Electrical Equipment Building	7880G						X		--- see WPF comment above ---
Backup Air Compressor	7880S						X		--- see WPF comment above ---
High Flux Isotope Reactor Facility	7900						X		The energy is required to support the research mission. The reactor is an 85-MW isotope production and test reactor with the capability of performing a wide variety of irradiation experiments. When operating the energy intensity of the facility is about three times that of a standard building at ORNL. Energy loads are not influenced by conventional building energy conservation measures. Significant energy reductions are not practical without affecting research operations.

Center for Nanophase Materials Sciences	8610						X		This is a relatively new (2003) modern facility. Energy intensity is required for research missions involving materials, neutron and X-ray scattering, electron microscopy and spectroscopy, and other processes, and the facility also incorporates 10,000 square feet of Class 100, 1000, and 100,000 clean room space. The energy intensity of the facility is about three times that of a standard building at ORNL. Significant energy reductions are not practical without affecting research.
Spallation Neutron Source (SNS) process facilities, as follows:	*See comment at right:*								The SNS buildings listed below make up the process buildings required for SNS operations. At full power, the SNS will provide the most intense pulsed neutron beams in the world for scientific research and industrial development. Completed in May 2006, SNS has ramped up to near full-power capability. Energy intensity is required for research missions. Energy loads are not influenced by conventional building energy conservation measures. Significant energy reductions are not practical without affecting research operations. (The Central Laboratory and Office Building at SNS are not exempt from energy goals, but only the buildings required for process operations.)
(SNS) Front End Building	8100						X		--- see SNS comment above ---
(SNS) Beam Tunnel	8200						X		--- see SNS comment above ---
(SNS) Klystron Gallery	8300						X		--- see SNS comment above ---
(SNS) Central Helium Liquifier Facility	8310						X		--- see SNS comment above ---
(SNS) Superconducting Rad Freq. Bldg.	8320						X		--- see SNS comment above ---
(SNS) RF Test Facility	8330						X		--- see SNS comment above ---
(SNS) HEBT Service Building	8340						X		--- see SNS comment above ---
(SNS) Ring HVAC Building West	8413						X		--- see SNS comment above ---
(SNS) Ring HVAC Building East	8423						X		--- see SNS comment above ---
(SNS) Ring Injection Dump	8520						X		--- see SNS comment above ---
(SNS) Ring Service Building	8540						X		--- see SNS comment above ---
(SNS) RTBT Service Building	8550						X		--- see SNS comment above ---
(SNS) Target Building	8700						X		--- see SNS comment above ---
(SNS) Target Building #1 Beam Line 1	8702						X		--- see SNS comment above ---

(SNS) Target Building #1 Beam Line 5	8705						X		--- see SNS comment above ---
(SNS) Target Building #1 Beam Line 7	8707						X		--- see SNS comment above ---
(SNS) Target Building #1 Beam Line 11	8711						X		--- see SNS comment above ---
(SNS) Target Building #1 Beam Line 13	8713						X		--- see SNS comment above ---
(SNS) Target Building #1 Beam Line 14B	8714B						X		--- see SNS comment above ---
(SNS) Helium Compressor Building	8760						X		--- see SNS comment above ---
(SNS) Switch Yard	8911						X		--- see SNS comment above ---
(SNS) Central Exhaust Facility	8915						X		--- see SNS comment above ---

Appendix B

Placeholder for ORNL Sustainability Highlights

Biomass Steam Plant

Electric Vehicle (EV) Solar Charging Stations at ORNL and Across the State of Tennessee

Central Energy Data System

Water Resource Management: Modernization and comprehensive management

Titan the World's Fastest Super Computer and it's Green

Wireless Energy Data

Electronically submitted via email from Teresa Nichols to Mary Rawlins (OSO, Federal Project Director).

Appendix C

Goal Summary Table

SC/SSPP/ OMB Goal	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
Goal 1: Greenhouse Gas Reduction and Comprehensive Greenhouse Gas Inventory				
1.1	Energy Intensity Reduction 30% by FY 2015 from a FY 2003 baseline.	In FY 2012, ORNL achieved a reduction of 30.1%, currently on track to reach the 30% goal by FY 2015.	Ongoing energy audits in progress will identify energy conservation projects to maintain the 30% goal.	**Low:** Goal was obtained in FY 2012. If additional projects are not implemented due to budget issues, the outlook and risk of attainment could change.
1.2	7.5% of annual electricity consumption from renewable sources by FY 2013 and thereafter (5% FY 2010–2012).	In FY 2012 ORNL supplemented ongoing activities by procuring 31,829 MWh of REC from Wind Resources, plus Green Power from TVA to offset on-site production yielding 6.2% of all power, meeting the goal for FY 2012. Onsite renewables solar power is 0.046% of ORNL total electrical consumption.	Several renewable energy projects are under review for consideration, and while some are not life-cycle cost-effective, other funding and purchasing options are being discussed. Investigating additional onsite generations such as PV and green gas generation.	**High:** Budget constraints in FY 2013 and beyond may limit funds needed for on-site renewable energy projects without partnering agreements. ORNL power consumption is projected to increase significantly, so achieving the goal will be increasingly difficult.
1.3	SF_6 Reduction	The SF_6 process loss in FY 2012 is calculated at 18,429 $MTCO_2e$ (from releases of 1,700 lb), a 32% reduction from the FY 2008 baseline of 27,102 $MTCO_2e$ (from releases of 2,500 lb), and an even greater improvement from the FY 2011 estimate of 168,828 $MTCO_2e$ (an 84% year-over-year reduction).	All ORNL SF_6 process losses result from operation of the HRIBF tandem accelerator. Effective surveillance and maintenance, ongoing system upgrades, and efficient future operations will minimize future SF_6 losses.	**Medium:** Risk of non-attainment of the GHG reduction goal is not easy to determine due to the unknown programmatic status/funding for the HRIBF facility.
1.4	Individual buildings metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015).	Due to an aggressive site Metering Program, ORNL is largely in compliance with DOE mandates by achieving 91.7%, surpassing the goal for electrical use. The balance of the electrical metering is anticipated to be completed by the end of FY 2015. The remaining systems are progressing toward full compliance.	Continued implementation of metering plan, in order to finalize compliance with respect to metering of all commodities. Goals have been met in respect to natural gas, chilled water, potable water, steam, and data center requirements.	**Low:** Although operating budgets in FY 2012 and beyond have limited special funding for implementation of metering projects, ORNL has very little additional work needed to comply with the goal. Remaining meter installations are dependent upon synchronization with outage scheduling.

SC/SSPP/ OMB Goal	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
1.5	Cool roofs – all new roofs must meet Cool Roof standards and have thermal resistance of at least R-30.	In FY 2012, ORNL completed approximately 60,000 square feet in new cool roofs.	All new construction and renovated facilities will employ cool roof technologies.	**Low:** ORNL's Facilities Development Division standards and processes have been implemented that will assure continued use of cool roof technologies.
1.6	Training to ensure that facility energy managers can demonstrate the core competencies for facility managers.	Energy Efficiency Manager is a Certified Facility Manager and Certified Energy Manager. Complex Facility Managers were trained in environmental, safety & health topics and other Complex specific topics as required.	Identify functional core competencies as DOE-specific FBPTA guidance is issued. Analyze training needs for facility managers related to energy management and provide training opportunities.	**Medium:** Budget constraints could limit ability to obtain external training. Recent reductions in staff could impact scheduling of courses.
1.7	Net Zero energy in new or major renovation facilities.	New design work will comply on defined schedule.	New design work will comply on defined schedule.	**Medium:** Cost of design could affect non-attainment.
1.8	Evaluate 25% of 75% of facility energy use over four-year cycle.	On target: The JCI ESPC evaluation in FY 2008 provided the first 100% audit of the ORNL campus.	In FY 2012, completed the four-year cycle of the plan developed in FY 2009 to evaluate at least 25% of the covered facilities annually.	**Low:** For FY 2013 and beyond audits will be conducted using a combination of cost effective approaches.
1.9	13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline.	FY 2012: Scope 3 estimate is 44,328 $MTCO_2e$. Challenge to meet target. Overall Scope 3 grew by 8%. While employee commutes (-6%), business air travel (-9%) and business ground travel (-9%) have improved, a 31% growth in T&D losses limits the overall performance.	Focus areas are employee commute and telework to ensure progress toward Scope 3 reductions that are related to employee engagement. T&D losses T&D losses will be minimized by a new substation (operational FY15) that will reduce the T&D losses on the medium voltage distribution system. Although reduced, T&D losses will rise in proportion to electrical energy used.	**High:** Overall risk of non- attainment of 13% reduction is high due to T&D losses from TVA power, as consumption grew by 46% from the baseline to FY 2012 and is expected to increase by 174% by FY 2020 (from the FY 2008 baseline).
1.10	28% Scope 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline.	FY 2012 Scope 1 estimate is 61,257 $MTCO_2e$, a decrease of 32% from FY 2008. With Renewable Energy Credits (RECs) in FY 2012 to avoid GHG emissions, the Scope 2 estimate is 295,077 $MTCO_2e$, an increase of 18% from FY 2008. A FY 2012 Scope 1 and 2	**Scope 1** reductions are on target due to ECM efforts and the results from the ESPC implementation. The Biomass Steam Plant reached operational status in July, 2012. **Scope 2** reductions represent more of a challenge due to growth	**Scope 1: Low:** ESPC and Biomass Steam Plant implementation are keys to attainment. **Scope 2: High:** Risk of non-attainment of 28% reduction is high due to growth in electricity usage. Consumption grew by 45% from the FY 2008 baseline to FY

SC/SSPP/ OMB Goal	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
		combined estimate of 356,334 $MTCO_2e$, is an increase of 5% from the baseline year of FY 2008.	in electricity demands for mission critical facilities.	2012 and is expected to increase by 174% by FY 2020. Overall Scope 1 & 2 reduction goals are not attainable without the implementation of transformational energy projects (innovation) such as the SMR technology as detailed in section 8.1.
Goal 2: Buildings, HPSB, ESPC Initiative, Regional and Local Planning				
2.1a	15% of existing buildings greater than 5,000 gross square feet (GSF) are compliant with the Guiding Principles (GPs) of HPSB by FY 2015.	Four additional existing buildings achieved HPSB status in FY 2012 for a total of 17; currently on track to reach goal of 15% by FY 2015.	17 of the 22 required buildings at ORNL have achieved HPSB status by end of FY 2012; currently on track to reach goal of 15% (22 buildings) by FY 2015.	**Medium:** The operating budgets in FY 2013 and beyond may limit special funding for implementation of necessary facility modifications, which could impact the goal.
2.1b	All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs.	To date, 15 new facilities have been LEED certified. Four are LEED Gold, 2 more are pending LEED Gold. Two buildings are LEED Silver. One additional building will be constructed to LEED Gold by 2015.	*All* new construction is specified for LEED Gold as a routine part of the facility development process.	**Medium:** Cost constraints FY 2013 and beyond may limit funding for the implementation of necessary facility design and construction requirements, which could impact meeting the goal.
2.2	ESPC Initiative	Non-quantitative goal	ORNL continues to have planned discussions with Site Office. These include accomplishment of ECMs from CEDR and possible onsite generation projects.	**High:** Although informal discussions have been held with ESCOs, no notice of opportunity has been submitted.
2.3	Regional & Local Planning	Non-quantitative goal	Specific regional and local planning activities will be considered based on feasibility, cost, and potential impact.	**Medium:** ORNL has a strong network of stakeholders who are engaged in local and regional planning.
Goal 3: Fleet Management				
3.1	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline.	On target: 38% of alternative fuel was consumed in 2005; increased to 75.5% alternative fuel consumption in 2012.	Continue to use alternative fuels and continue to educate drivers about the importance of using alternative fuels in Flex Fuel vehicles to meet the Goals.	**Medium:** An interruption in the availability of alternative fuels is the biggest risk, and ORNL has little control of fuel markets. Availability has been an issue at certain times in the past.

SC/SSPP/ OMB Goal	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
3.2	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline.	The target for meeting this goal should be at a 14% reduction for FY 2012. In FY 2012, ORNL had achieved a 21% reduction.	Continue to use alternative fuel. Continue to ensure biodiesel integrity is maintained.	**Medium:** If the availability of alternative fuels is interrupted, then Flex Fuel vehicles could be forced to use gasoline.
3.3	100% of light duty vehicle purchases must be AFVs by FY 2015 and thereafter.	Light duty vehicle purchases in FY 2012 were 100% AFVs.	Continue to purchase AFVs from GSA schedules as funds and approvals are available.	**Low:** All vehicles purchased will be AFVs. However, the cost of GSA schedule electric vehicles remains too high to consider.
3.4	Submit Right-Sizing the Fleet Management Plan for approval by Dec. 31, 2012. Identify mission critical/non-mission critical vehicles by December 31, 2012.	Right-Size Fleet Plan will be submitted by deadline.	Prepare the plan based on provided directions.	**Low:** Right-Size Fleet Plan will be completed as established in Goal.
Goal 4: Water Use Efficiency and Management				
4.1	26% potable water intensity (G/GSF) reduction by FY 2020 from a FY 2007 baseline.	Significant savings were realized in FY 2012 that resulted in a water intensity of 114 G/GSF, which exceeds the FY 2020 goal. (A reduction of 35% to date).	Additional savings are planned that include eliminating additional once-through cooling and repair of leaks in the water distribution system.	**Low:** Current performance of 114 G/GSF exceeds the FY 2020 water intensity goal of 130 G/GSF as established as the baseline.
4.2	20% water consumption reduction of ILA water by FY 2020 from a FY 2010 baseline.	No industrial, landscaping, and agricultural (ILA) water use at ORNL.	No ILA water use at ORNL.	No ILA water use at ORNL.
Goal 5: Pollution Prevention and Waste Reduction				
5.1	Divert at least 50% of nonhazardous solid waste, excluding construction and demolition debris, by FY 2015.	A 33% diversion rate was achieved in FY 2012. While less than the target, this represents a significant improvement in the past year.	Continue mediation measures and process improvement in FY 2012 to assure attainment.	**Medium:** The operating budget in FY 2013 and beyond may limit funding for the implementation of a suitable program to ensure attainment of goals.
5.2	Divert at least 50% of construction and demolition materials and debris by FY 2015.	ORNL's diversion rate for construction and demolition debris is greater than the 50% goal for FY 2012 (78.6%).	Continue process improvements to meet or exceed the goal by FY 2015. Additional focus will be place on segregation of waste.	**Low:** Implementation of work processes such as progressive subcontract procedures and better waste segregation to ensure compliance with goals.
Goal 6: Sustainable Acquisition				
6.1	Procurements meet requirements by	100% of all procurement transactions in FY 2012	Procurements transactions will	**Low:** Standard work processes and business

SC/SSPP/ OMB Goal	DOE Goal	Performance Status	Planned Actions & Contribution	Risk of Non-attainment
	including necessary provisions and clauses (Sustainable Procurements / Biobased Procurements)	(excluding purchase card transactions) contained terms and conditions that invoke requirements for sustainable acquisitions.	continue to include standard UT-Battelle terms containing sustainable acquisition requirements. Will investigate scenarios to improve the performance of purchase card transactions.	flow procedures ensure inclusion of required provisions in standard procurements. Opportunities will be pursued to improve purchase card performance with goals.
Goal 7: Electronic Stewardship and Data Centers				
7.1	All data centers are metered to measure monthly power utilization effectiveness (PUE) (100% by FY 2015).	All data center equipment is metered; plans are developed for additional BTU meters on chilled water lines.	Install the remaining BTU meters in FY 2013 so that PUEs can be calculated more directly and more accurately.	**Low:** All equipment is currently metered and additional system metering capability is planned.
7.2	Maximum annual weighted average PUE of 1.4 by FY 2015.	The calculated PUE value at year end FY 2012 is 1.29 for the Building 5300 data center and 1.26 for Building 5600.	See goal 7.1 above: It is expected that with the addition of additional system meters, and with continuous improvement, the PUE calculations will be more accurate.	**Low:** The PUEs can be calculated now; however, some indirect calculations need to be made. New meters and storage equipment will help to stabilize the results so the goals will consistently be met.
7.3	Electronic Stewardship – 100% of eligible equipment with power management actively implemented and in use by FY 2012.	All eligible PCs and monitors are actively power-managed.	Final implementation of the upgrade to the Verdiem server to include Macintosh systems will be complete in FY 2013.	**Low:** Continue to actively ensure all eligible computing equipment is power managed.
Goal 8: Innovation & Government-Wide Support (Non-quantitative Goal)				
8.1	The goal for innovation at ORNL is to help DOE maintain US global leadership in science, engineering, and energy management.	ORNL continues to be actively engaged in regional and local planning for transportation options as well as outreach activities for the enhancement of sustainability effort in the entire southeast region.	Specific innovative projects detailed in section 8.1 will be considered based on feasibility, cost, and potential impact.	**Medium:** ORNL has a strong network of stakeholders who are engaged in local and regional planning. Opportunities for regional action continue to be pursued.

Appendix D

Placeholder for the Consolidated Energy Data Report (CEDR) Submission

Electronically submitted via email from Brice Hudey to Mary Rawlins (OSO, Federal Project Director).